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A SYSTEM
OF
OPERATIVE SURGERY,
&c. &c.

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A SYSTEM
OF
OPERATIVE SURGERY,
CONTAINING
A DESCRIPTION
OF
THE MOST APPROVED PLANS
OF PERFORMING THE DIFFERENT OPERATIONS IN SURGERY
ON THE DEAD BODY ;
WITH
REMARKS ON THEIR ANATOMY,
AND ACCOMPANIED WITH
PRACTICAL OBSERVATIONS :
BEING PRINCIPALLY DESIGNED FOR THE
USE OF STUDENTS IN SURGERY.

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TO THE
MEDICAL AND SURGICAL STUDENTS,
OF THE
BRITISH SCHOOLS,
THE FOLLOWING WORK
IS INSCRIBED BY
THE AUTHOR.

P R E F A C E.

THE object in undertaking the following work, is to bring before the surgical student the most approved plans of performing surgical operations ; and to condense them into as concise a form as the nature of the subject will admit ; as I regret to think, that our language is still meagre in treatises on this important branch of SURGERY. It is also intended as a text book for those gentlemen who honour the Author with their attendance on the lectures which he delivers in this department of our profession.

In none of the works as yet published on Operative Surgery, is relative anatomy, in my opinion, insisted on with that degree of accuracy, which appears to me so necessary to connect it with surgery, and to form one connected system : accordingly my attention has been particularly directed to this point, to introduce it to the student's notice in the clearest manner. As a complete knowledge of relative anatomy will alone enable him to

act with confidence and decision in the trying scenes, which in after life may be presented in his professional career.

The design of the work consists in presenting to the pupil's attention those operations which can be performed on the dead subject; such as the securing of the arteries, amputations, excision of joints, extirpation of different organs, laryngotomy, tracheotomy, œsophagotomy, lithotomy, catheterism, hernia, trephining. I have purposely omitted the operations connected with the interior of the eye, as I consider them foreign to this treatise; in fact, they ought to be studied in conjunction with ophthalmic surgery, for which purpose, in most instances, the student can avail himself of the eyes of the inferior animals to operate on when in his closet, and has no occasion for the use of a dissecting room to practise them in.

All the operations connected with this division of surgery, will be found embodied in the standard works on diseases of the eye.

In the sections devoted to the anatomy of the different textures interested in each operation, the fullest attention has been paid to describe it with the most exact fidelity; it has been my constant practice to detail it actually from the subject, the scalpel à la main. If I appear to be prolix, and in some instances have not avoided repetition, it is pleaded in extenuation of this

defect, that it has arisen from an anxiety to place this particular subject in the most intelligible manner, that it may be fully comprehended.

In the part of the work that treats of the operations on the arteries, neither time nor repeated trials have been spared, to verify the different directions that are found scattered through the various surgical works, to ascertain their correctness: especial care has been also directed to indicate any irregularities in the course of the vessels which might mar the success of the operation. In every instance where it is possible, my wish has been to induce the student to be guided to the situation of the arteries by the muscles, and from osseous bearings, than by any series of lines; however correct the latter may be, still the former are always present, and on every occasion are our best directors to search for the vessel; whether it is sought for to relieve aneurism, or to be secured in case of its being opened.

When enumerating the successive layers of structure, that require to be divided to expose the parts engaged in an operation, the details may appear tedious and too minute, to some perhaps trifling; if the student and young surgeon be desirous not to confound parts one with another, they ought always to accustom themselves to divide the different layers of tissues mentally in numerical order; as it will allow them to go through the various steps of the operation with regularity and

precision. The adoption of such a system, will be found of infinite advantage when operating upon the living, as it will better prepare them for any irregularity they may encounter.

To most of the operations, observations of a practical nature are appended, which have been derived partly from my own experience, and partly from those, on whose judgment I would rely.

If my exertions shall be found of any benefit to the junior members of the profession, I shall hail it as a full consummation of my wishes, and consider that my time has not been occupied in vain.

DUBLIN, STEPHEN'S-GREEN,

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A SYSTEM
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OPERATIVE SURGERY,
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CHAPTER I.

ON THE PROPRIETY OF MAKING THE INCISIONS
WITH CARE AND CELERITY.

SIMPLE as the operation of dividing the integuments may appear, we read in works on surgery very minute and apparently prolix directions on this subject. Without entering into all the particulars of these details, it may not be uninteresting to say a few words on this part of operative surgery; particularly when it is remembered, that almost all operations consist in a series of incisions.

Every person is aware, that the principle of the saw is that on which all cutting instruments act; their edge being, in fact, if examined, toothed, and as, in using the saw, heavy pressure is not to be employed, so in making a solution of continuity by a knife, pressure would be

injurious ; as it would tend to tear the parts, and not divide them smoothly. Whence it follows, that in making an incision we should never have recourse to heavy pressure to divide the parts, but merely impart a slight force to the knife, as it is being drawn rapidly across them ; which, if done, they will immediately separate, as it were before it.

To accomplish this end with facility, as well as for the patient's comfort, the skin should always be rendered as tense as possible, which is sometimes produced by the diseased condition of the parts ; in other instances it must be effected by the surgeon or his assistant, and may be done in the following manner : he will place the ulnar edge of one hand on the integuments, and stretch them horizontally, while his fingers and thumb will render them tense in the opposite direction ; the knife, under the guidance of the other hand, will perform its office most satisfactorily, leaving a clean incision, with smooth edges.

Another point worth attending to, though not likely to interfere with the success of the operation, is, when making an incision, it ought never to form a "tail," which is partly caused by the edge of the knife lying for too great a length in contact with the skin, in consequence of not sufficiently elevating the handle towards the termination of the incision. It can easily be obviated, by raising the handle of the

knife perpendicular to the skin, as the line of division is being finished. Trifling as this remark may appear, an unsightly scratch will be avoided by attending to it, as well as some additional suffering to the patient.

For every useful purpose, the five positions for holding the knife or scalpel, described by Continental surgeons, may be reduced to two.

The first, and most usual position, is to seize the instrument where the blade joins the handle, with the middle-finger and thumb, the fore-finger advancing to a suitable distance from the point, whilst the remaining fingers, by being applied to the handle, fix it in the hand. The edge will thus be directed to the surface about to be divided; which is the position resorted to for making external incisions. The second position is represented by the manner in which a writing pen is held, and the edge of the knife is turned in a similar direction with the preceding. On some occasions this mode of holding the scalpel is used for extirpating tumours, making external incisions, and for the cataract knife or needle.

The ordinary division of external incisions, is into the linear, crucial, angular \vee , and \top shaped, the circular and elliptical. The linear incision may be made in one of two ways, either by stretching the skin with the ulnar edge of the left hand in one direction, while the fingers and thumb render it tense in an opposite, when the knife will rapidly divide the integuments so ad-

justed. Such is the usual mode of effecting this object, or it may be accomplished as follows: the integuments may be pinched up, and raised into a fold, which may be divided down to its base or point of reflection by a scalpel; now let it free, and a well made linear or longitudinal incision will be the result: this plan is adopted when the integuments are very thin, as is sometimes seen in hernia, and in other affections, in which every precaution must be taken in order to avoid wounding the subjacent parts.

The crucial incision consists of two linear ones meeting at an angle, and requires to be formed as follows: having made one leg of the cross, the other is to be so begun as to fall on that already existing; if, on the contrary, the second one, which completes the cross, commences from the edges of the first, the skin cannot be rendered tense, as it will fold under the knife, and a jagged incision will be the consequence.

Some perform the second incision by entering the bistoury under the skin at the solution of continuity, and passing it to the requisite distance, its surfaces lying flat; the edge is then turned forwards, and the point pushed through the integuments; the division of the latter is effected by drawing the scalpel outwards, which measures are repeated, in order to form the opposite line of the cross.

The angular incision \vee is derived from two

linear incisions meeting at an acute angle. When making them, they should be drawn to and not from the angle; the T shaped also results from two linear ones falling in some part of their course at a right angle on each other. The circular incision is seldom used; when employed, it is most frequently for the purpose of removing aneurism by anastomosis; while the elliptical is called for in extirpating tumours; these are both modifications of the linear.

In concluding these remarks, it may not be amiss to inculcate generally, the necessity of making, in the first instance, when commencing an operation, a free incision. Nothing can aggravate the pain of an operation to the patient, or the trouble of the surgeon more, than the necessity of extending the external wound after the operation has in part been gone through.

The incisions should be too long, rather than the contrary, as we are enabled thereby more easily to penetrate to the bottom of the wound, without any laceration or contusion of the soft parts; consequently, we are more certain of obtaining union by the first intention. The removal of tumours is also facilitated, and the additional suffering to which the patient is subjected from the increased length of the incision, is so very trifling, as to render it relatively a matter of no consideration.

CHAPTER II.

OPERATIONS FOR SECURING THE ARTERIES OF THE SUPERIOR EXTREMITIES AND NECK.

No operation in surgery requires more presence of mind, or correct anatomical knowledge, than that for securing a bleeding vessel, or cutting down to take up an artery which maintains an aneurismal disease: situated in most instances deeply, their precise position can only be known by a correct knowledge of their relation to contiguous parts, which serve as so many landmarks to guide to their situation: placed in some instances, too, amongst parts intimately connected with the well being and safety of the individual, parts which, if wounded, would compromise the safety of the patient and character of the surgeon.

An artery may require the application of a ligature in cases of hæmorrhage, aneurism, or for the purpose of repressing morbid growth depending on a given vessel for its unnatural nutrition. Previous to describing the steps of the

operations necessary in each case, and the relative anatomy of the vessels, it may be allowed to make a few observations on the manner of applying a ligature, which every practical surgeon must admit is the most certain mode at present known for attaining the object desired, namely, the obliteration of the injured vessel, and in this manner the permanently arresting of the flow of blood through it. In this city, of late years, many attempts have been made to improve on this gift of Ambrose Paré to the human race; which were principally directed to modify the “*presse artère*” of Deschamps, either as regards its application or its mechanism; a few cases were attended with success, but the majority failed, and the ligature has resumed the superiority which it had so decidedly gained.

When a ligature is to be applied to a bleeding vessel, it should be seized with a tenaculum or forceps, and gently drawn from the surrounding parts, care being taken that neither nerve nor vein is included by the instrument, in fact that it holds nothing but the vessel itself; the ligature should then be applied at right angles to its axis, and drawn sufficiently tight to insure the division of the internal and middle tunics of the vessel, which is always indicated to the operator, by perceiving that something yields as he closes the ligature; one of the ends are to be then cut away, or both, as recommended by M. Lawrence and other practitioners.

If the ligature is to be applied to an artery, in consequence of aneurism, or to repress morbid growths, as a general rule before passing it round the vessel, the limb should be always flexed; this manœuvre, trifling as it seems, will render the vessel flaccid, and allow the instrument conveying the ligature to be passed under it with the greatest ease; also when the vessel is being denuded, the surgeon should be careful not to detach too much of the cellular membrane from it, for the purpose of making a clean dissection. Should he neglect the last precaution, and make a clean dissection of the vessel, almost to a certainty secondary hæmorrhage will supervene; for the *vasa vasorum* of the artery have been destroyed, which principally assist in the process necessary for the adhesive inflammation, on which all our hopes depend to prevent hæmorrhage; if this salutary effort is interrupted ulceration follows, and causes the mischief so much dreaded. It will be merely requisite to expose the vessel to a sufficient extent, as that none of the neighbouring parts be included in the ligature, which is to be tied in the same manner as directed for a bleeding artery.

When a small branch springs from an artery immediately above the place where a ligature is about to be applied, it will be prudent either to carry it above this point, or the branch itself ought to be secured: the surgeon, by availing

himself of this precaution, will insure the operation of the ligature on the main trunk, in which a coagulum will form; that, otherwise, would be very doubtful, if the small vessel alluded to was allowed to remain open; as the blood would still circulate freely in the main trunk, even to the ligature, and inevitably prevent the formation of the internal coagulum.* I would advise the student to consult Dr. Jones' very valuable work on Hæmorrhage on this subject.

When the ligature is to be applied in consequence of an aneurism so situated (for instance the subclavian as it lies under the clavicle) that it cannot protrude externally, it will be then found to bury itself amongst the deep-seated parts; in doing which, the aneurism may overlap the artery above or below its origin. In such a case, whether the ligature be tied on the cardiac side or distal of the tumour, it ought to be at some distance from it, for, if the aneurism overlaps the artery, and the ligature is applied close to the sac, it may be laid open by the knife when endeavouring to expose the vessel too near the disease; or the point of the needle,

* Many cases of secondary hæmorrhage occur in consequence of this practice being neglected, *i.e.* allowing a vessel to communicate with the principal trunk, immediately above or below the place where the ligature is applied. A very interesting case of this kind occurred in the practice of M. Dupuytren, *v. Repertoire, Generale d'Anat. et de Physiol.*, No. 4, 1827-8.

when passing under the vessel, may puncture the sac, and give rise to a fatal haemorrhage.*

In the preceding paragraph I have alluded to the application of the ligature on the distal side of the aneurism, or that farthest from the heart. This practice was first advised by Bras-d'or or Desault, about sixty years since, and was not carried into execution for some time, when M. Deschamps put it to the test in a case of femoral aneurism; the result was most unfortunate. Sir A. Cooper revived it in a case of aneurism of the external iliac, with no better success; and within these few years it has been again brought before the profession by Mr. Wardrop, who availed himself of its application on the only vessel upon which it is most likely to be attended with success, namely, the carotid artery. My reasons for this opinion will be mentioned when describing the operations upon that vessel.

I conceive that Mr. Wardrop deserves well of the profession, for testing this practice in the manner he has; and from the testimony evidenced in his work, lately published, in favour of this method,† he has induced surgeons to tie the vessel on the distal side of the aneurism, when

* *Vide Johnson's Medico Chirurgical Review* for July, 1827, p. 189, for a case in which the sac was injured by the needle in the manner alluded to.

† *Wardrop on Aneurism.* London, 1828.

situated at the commencement of the carotids, and even of the subclavians, with a probability of success, which otherwise would be abandoned as hopeless, it being impossible to apply the ligature on the cardiac side of the tumour.

Radial Artery, on the dorsal surface of the hand, before it dips into the deep palmar arch.—The hand being placed between pronation and supination with the thumb abducted from the index finger; an incision being made parallel to the tendon of the extensor secundi internodii pollicis manus, which is readily found by throwing the muscle into action, and to its ulnar side, will divide the skin, superficial fascia, and some of the radicles of the cephalic vein; the cellular membrane being cleared away, the artery will be immediately seen, and is to be tied with two ligatures.

Relative Anatomy. The artery in this part of its course runs to the angle formed by the bases of the first and second meta-carpal bones, to penetrate to the palm of the hand; it has the tendon of the extensor secundi internodii muscle to the external side, and that of the extensor carpi rad. longior to the internal one; also some filaments of the musculo-spiral nerve; which ought not to be included in the ligatures.

Radial Artery, near the wrist. The fore-arm being extended and supinated, on a line that will pass from the centre of the bend of the arm to the styloid process of the radius, or a finger's breadth external to the tendon of the flexor carpi

radialis muscle, an incision is to be made about two inches long through the skin and superficial fascia, the deep-seated is next to be divided, which will expose the vessel; under it two ligatures are to be passed, and tied.

Relative Anatomy. In this part of its course the vessel is only covered by the skin and superficial fascia, under which frequently a more dense one is found, that confines the artery *in situ*. The tendon of the flexor carpi radialis muscle lies a little to the ulnar, while some branches of the muscle-spiral nerve descend on the radial side of the vessel to the hand; it is always accompanied by two veins.

Observation. In aneurism of this vessel near the wrist, the superior part of its calibre has been found obliterated, and the sac filled from the inferior portion, owing to the free communication between the radial and ulnar arteries, by means of the palmar arches; this fact indicates the necessity of applying a ligature to the vessel both above and below the disease. In some instances I have seen the superficialis volæ artery to arise from the radial four inches above the usual origin, and descend to the ball of the thumb, parallel and internal to the parent trunk; it may be confounded with the vessel in question in the living subject.

Radial Artery, near the bend of the arm. Having supinated the fore-arm, and made the ulnar edge of the supinator carpi rad. longior evident, along it an incision should be carried for two inches, and the skin cautiously divided, till the inner edge of the muscle is exposed; if it is

much developed, the artery will be found overlapped by it, if not, the vessel will be seen to run parallel to, but deeper than the muscle; when the latter conceals the artery, it is to be drawn to the radial side of the arm, to bring the vessel into view.

If it is not possible to find the inner edge of the muscle above mentioned, the following rule of M. Lisfranc, will serve as a correct guide to ascertain the course of the artery. From the centre of the bend of the arm, let a line be drawn downwards and with a slight degree of obliquity outwards for three or four inches; then from the point where it terminates inferiorly, another is to be extended to the bend of the arm, at which place it is to be distant from the first by not more than a quarter or half an inch, and to its external side. The second, or external line, indicates the direction that the incisions ought to take, so as to expose the artery.

Relative Anatomy. In this part of the fore-arm the cephalic vein frequently runs parallel and anterior to the course of the artery in the very line of the cutaneous incision: it may be always avoided, since its situation can be ascertained prior to commencing the operation, by compressing the veins at the bend of the arm; many small twigs from the perforans Caserii, or external cutaneous nerve, must be divided in the first incision. After the ulnar edge of the supinator carpi rad. longior is exposed, I have often observed a tolerably dense fascia to proceed from the external edge of the tendon of the

biceps flexor cubiti outwards, between the muscle already mentioned and the extensor carpi rad. longior ; when present it covers the vessel, and would embarrass the surgeon if he was not aware of its occasional existence. Under this fascia the artery is seen, anterior to the supinator carpi rad. brevior and the pronator teres muscles ; whilst in close contact, but on the radial side of it, the continued trunk of the musculo-spiral nerve passes to the hand, and ought not to be included in the ligature ; when the patient is very muscular, it will be recollected, that the supinator carpi rad. longior overlaps the vessel.

Ulnar Artery, near the wrist. After the forearm is supined and extended, the operator will examine for the insertion of the tendon of the flexor carpi ulnaris muscle into the os pisiforme, and will commence his incision about half an inch above and a few lines to the radial side of the bone, carrying it upwards for two inches parallel to the tendon, and divide the tegumentary coverings and deep fascia, if it exists. By this incision, the tendon of the muscle will be exposed with the ulnar nerve, which is a little external and deeper than it ; whilst the artery accompanied by its two veins will be found at the radial side of the nerve. For similar reasons that the radial artery requires two ligatures in this situation, it will be also necessary to use the same number to secure the vessel of which we are treating.

Relative Anatomy. The ulnar artery in this situa-

tion is covered in the same manner as the radial, viz. by the superficial and deep fascia, that binds it down, and should be divided before the ligatures can be conveyed under it; the relation to the nerve and tendon of the flexor ulnaris muscle, has been mentioned in the preceding paragraph.

Ulnar Artery, in the middle of the fore-arm. The limb being supinated and extended, the operator can avail himself of the course of the tendon of the flexor carpi ulnaris muscle, which can be rendered evident by depressing the hand in the dead subject, or putting it into action in the living, to direct the incision, which is to be made parallel and external to the outline of that part of the muscle. The integuments and fascia being divided to the extent of two inches, the radial side of the tendon will be exposed ; the handle of the knife is then to be introduced to separate it from the flexor sublimis digitorum, which in most instances conceals the artery ; the ligatures are then to be applied.

Relative Anatomy. In this situation the artery is seldom at any depth from the surface, and descends to the hand on the flexor digitorum profundus ; it is in muscular subjects always covered by the internal edge of the superficial flexor digitorum, and is similarly related to the nerve, as in the preceding operation.

Ulnar Artery, near the bend of the arm. The fore-arm being in the same situation as in the last operation, also abducted from the trunk, the

student is to draw a line from the internal condyle of the humerus, to the styloid process of the ulna ; about two fingers' breadth below the condyle, he will commence the incision, and be conducted by this line towards the inferior extremity of the ulna for at least three inches ; the skin being penetrated, the strong fascia that covers the muscles which take their origin from the internal condyle of the humerus is exposed, and is to be divided to the same extent as the integuments.

The intermuscular space situated between the flexor sublimis anteriorly, and profundus digitorum posteriorly, is next to be entered, and the fingers or the handle of a scalpel insinuated between them, in order to pass towards the median line of the fore-arm ; if any difficulty is experienced in this part of the operation, it will be surmounted by flexing the elbow joint, which will relax the muscles to so great an extent, that no impediment will be presented to the fingers to penetrate to the centre of the fore-arm ; near to it, the vessel, if running its usual course, will be found around which the ligature is to be tied.

Relative Anatomy. In this operation, the intermuscular space so necessary to be found, and which will conduct us in an infallible manner to the vessel, is bounded anteriorly by the flexor sublimis digitorum, posteriorly by the flexor carpi ulnaris and flexor profundus digitorum muscles ; as the operator proceeds in search of the artery, he first meets the ulnar nerve, next the vessel

at some distance from it on the radial side, finally, by dipping deeper between the muscles, the median nerve will be seen descending external to the two other structures.

Observation. The artery in this part of its course, sometimes runs subcutaneous down the fore-arm to the wrist; occasionally it is observed to be superficial for the upper third of the limb, after which it dips in between the muscles, and follows the ordinary distribution of the vessel.

If the incisions be free and extensive, by this operation the ulnar artery, if necessary, may be secured as high even as its origin from the brachial.*

Brachial Artery, at the bend of the arm. Having extended the fore-arm on the arm, the operation may be proceeded in, by making an incision about half an inch internal to the edge of the bicep's tendon, directing it upwards and a

* Since these sheets went to press, I have received Mr. Guthrie's work on the Diseases and Injuries of Arteries, and avail myself of the following passages which elucidate the practicability of securing the ulnar artery in the upper third of the fore-arm, in case of being wounded.

"The artery being opened by a slanting wound from the ulna to the radius, the surgeon, if he thinks he can calculate the point at which it is wounded, will cut down upon it in the direction of the fibres of the intervening muscles; but if he has erred in his calculation, he must introduce a probe, and after having ascertained the line the wound has taken, he should cut across the muscles in that direction, until he exposes the bleeding artery; and if he is careful not to divide the median nerve, no inconvenience will arise from the operation."—Page 405.

little inwards for two or three inches, through the skin and superficial fascia; whatever portion of the fascia, which is derived from the tendon of the biceps muscle, and lies anterior to the artery, is next to be slit up, by which the intermuscular ligament will be laid bare; after it is opened to the requisite extent, the vessel will be found, accompanied by two veins, in a triangular space, formed externally by the biceps muscle, internally by the pronator teres, and posteriorly by the brachialis anticus.

Relative Anatomy. The vessel in this situation is covered by the median-basilic vein, often by the basilic itself, and by numerous filaments derived from the internal cutaneous nerve; all these lie in the common integuments; while subjacent to them, the vessel derives a partial protection from the fascia of the biceps tendon, and is always covered by the intermuscular ligament; as it passes down on the brachialis anticus muscle, it is accompanied by the median nerve, placed to its ulnar side.

Observation. When performing this operation, the incisions should never be made close to the internal edge of the biceps tendon, as they will then be external to the vessel; and if the dissection be continued, in all probability the surgeon will pass between the biceps and the brachialis anticus muscles, and consequently be completely astray, as he will be external to the artery. By attention to the preceding instructions, the vessel will be met with, and can be easily secured. The operator must divide, in his superficial incisions, some filaments of the internal cutaneous nerve, while the median basilic and basilic veins will run some danger of being wounded.

Brachial Artery, in the middle of the arm.

The limb being extended and rotated outwards, the integuments are to be divided, parallel to the internal side of the belly of the biceps for a couple of inches, until the fascia of the arm is exposed, which is to be laid open to the same extent as the skin, by passing a director under it, and on which it ought to be slit up.

To the external side of the incision is the biceps, to the internal the median nerve, while the artery will be found situated between and a little posterior to them, accompanied by its veins, from which it is to be insulated, and a ligature applied.

Relative Anatomy. In this part of the arm, the artery in a muscular man is partly covered by the belly of the biceps muscle, particularly where it crosses anterior to the insertion of the coraco-brachialis. In this situation, when the parts are not disturbed by much dissection, the median nerve, with few exceptions, lies on and anterior to the artery, while lower down the nerve passes internal to it; we also perceive the internal cutaneous nerve in the line of the incision, and anterior to the artery.

Observation. I wish to impress on the mind of the student, the necessity of taking the inner edge of the biceps for his guide, when cutting down on the brachial artery in this situation, in preference to the general course of the vessel, which may be indicated by a line drawn from the centre of the axilla to that of the bend of the arm; if the latter is selected, the slightest deviation from it pos-

teriorly, will lead him away from the artery, where he will find a large nerve, the ulnar, which may be readily taken for the median, being nearly of equal size ; in the same situation he will also meet with an artery, the inferior profunda, which has the same relation to the ulnar nerve that the brachial artery has to the median. This disposition of the parts may so impose on the pupil, that he will be induced to consider it as the vessel he is in search of, and enclose it in a ligature ; whilst, on the contrary, by cutting parallel with the internal edge of the biceps, it is next to an impossibility for any mistake or confusion to occur ; for all the nerves and arteries are subjacent to the incisions, which expose first the median and internal cutaneous nerves, next the brachial artery placed posterior and in a slight degree external to them, *i. e.* nearer to the humerus ; in fact, this vessel will be the first that the dissection will present to the student's notice as he incises along the biceps.

Brachial Artery, in the superior third of the arm, where the axillary terminates in it. The arm being extended so as to form a right angle with the trunk, or what is better, to an obtuse one, the incision is to be commenced in the centre of the inferior part of the axilla, and carried downwards for a sufficient distance on the line alluded to in the observation of the preceding page ; the skin and fascia, when divided, will permit the brachial vein to be seen, which almost invariably covers the artery ; it is to be drawn to the internal side of the wound, and the artery being separated from whatever connec-

tions it may have to the median, internal cutaneous, and ulnar nerves, can then be tied.

Relative Anatomy. In this situation the brachial artery is very superficial, being covered by the vein and integuments, which are extremely thin, and require to be divided with caution, or the subjacent parts will be injured ; it is closely impacted between the median and external cutaneous nerves on one side, while the ulnar and internal cutaneous confine it on the other.

Observation. In this, and the preceding operation, by having the arm rotated outwards, the depth of the wound will be diminished, and the artery brought forwards, at the same time that the median and internal cutaneous nerves will be removed towards the internal side of the incision, away from the vessel ; this manœuvre will afford great facility to discover the artery, without any apprehension of confounding it with any other texture.

The frequent irregularities that the arteries are liable to in this part of the system, will produce not alone considerable embarrassment, but often unsuccessful practice will result when operating on this vessel, in any part of its course, from the commencement to the termination, unless these are borne in mind.

They are as follows : 1st, Occasionally the superior profunda is seen to rise from the posterior circumflex of the axillary artery, and descend anterior to the conjoined tendons of the latissimus dorsi and teres major muscles, parallel to the brachial, but internal and posterior to it ; at the same time it is accompanied by the musculo-spiral nerve.

This distribution presents us with a large vessel, pur-

suing the same course as the brachial itself, also simulating it by the large nerve that descends along with it. How are these two vessels to be distinguished from each other in the living subject? If the internal edge of the biceps muscle be taken as our guide, it will conduct us with the greatest certainty to the vessel we wish to secure, namely, the brachial artery, which is always the first to be met with as the operator passes from the anterior towards the posterior part of the arm. 2nd, A high bifurcation of the brachial into the radial and ulnar arteries, both vessels descend parallel to each other, the radial being next to the biceps; having arrived at the bend of the arm, the latter may run either anterior or posterior to the fascia belonging to the tendon of that muscle; it generally passes under this expansion, while the ulnar artery takes its usual course.

3rd, The division may take place at the centre of the humerus, and the radial run very superficial, at the bend of the arm being placed immediately under the cephalic vein.

4th, The ulnar artery has been observed to descend from a similar point under the integuments along the fore-arm to the hand; or it may dive between the muscles towards the middle of the fore-arm.

5th, The ulnar arises occasionally in the axilla, descends parallel to the brachial, as far as the bend of the arm; a little above which place, a short,* transverse, and full sized vessel is sent from the ulnar to communicate with the brachial. In such an irregularity, the

* In this case I name it the brachial, because it ultimately furnishes the radial, and interosseous arteries of the fore-arm.

transverse branch will convey blood from either vessel ; consequently, both vessels require to be tied, if the operation is performed at the superior part of the arm. This is a very rare variety.

6th, In some extreme and unusual cases, the axillary artery has been found to form a kind of axis, and divide into the radial, ulnar, and interosseous arteries, which descended along the humerus, parallel to each other, till they arrived at the bend of the arm, from whence they continued their courses in the usual manner.

7th, I this season observed the radial artery to come from the parent trunk, about the middle of the arm, and descend on the internal side of the brachial, separated from it by the median nerve ; when the vessels arrived at the flexure of the arm, the radial crossed anterior to the nerve and the artery, to pass to the external side of the biceps tendon.

These irregularities are often the cause of much embarrassment to the surgeon when operating on the living subject ; he secures an artery, and, to his great surprise, perceives the affection that called for the operation is not benefited by it, as the blood still continues to flow, either from the wound, or into the aneurismal sac. Such an occurrence points out the necessity of examining whether any irregularity exists ; if such is proved to be present, before closing the ligature, the surgeon ought alternately to compress both vessels between his fingers, to ascertain what effects are produced at the seat of injury ; and the vessel which, by compression, is seen to communicate with the disease, ought to be immediately secured ; if no positive evidence can be obtained from this trial, both arteries are to be tied.

The enumeration of these varieties in parts so often subject to operation, cannot be too strongly impressed upon the student's mind, to induce him to bestow every attention to the relative anatomy of this region, that he may acquire a perfect knowledge of it: they also inculcate the cautious proceedings necessary to be observed when attempting to secure the artery, so as to leave the operation perfect.

Axillary Artery, towards its termination. The subject is to be placed in the horizontal position on a table, and the arm raised towards the head as much as possible, and rotated outwards, the hair being previously shaved. In this and the succeeding operations on the axillary vessel, the circulation can be completely arrested by compressing the subclavian artery as it passes over the first rib; this fact, once so cavilled at by Mr. Bell, is now so well known to every person in the profession, that it is unnecessary to dwell upon it. An incision is then to be made from the centre of the axilla, to the inferior edge of the conjoined tendons of the latissimus dorsi and teres major muscles, through the skin and superficial fascia, which will bring into view the axillary vein, with others derived from the scapula, also the median, and internal cutaneous nerves; on the axillary vein being separated from the median nerve, the artery will be found placed between them, and somewhat deeper, accompanied by two small veins, from which it is to be insulated, and the ligature conveyed under

it from within outwards, *i.e.* from the posterior to the anterior side of the vessel.

Relative Anatomy. When the limb is thrown into the position now recommended, the head of the humerus descends into the axillary cavity, and the organs contained in it are carried before the bone, being rendered thus more superficial; after the division of the skin and fascia, many nerves are seen to envelope the vessel; the external root of the median and the perforans Casserii being situated at the superior side (or that which is bounded by the pectoralis muscle) of the axilla, whilst the internal root of the median, the ulnar, and musculo-spiral nerves lie at the inferior part of the cavity; partly posterior and between them is the artery, always covered by the vein.

Observation. The cutaneous incision in this operation demands considerable care, owing to the extreme thinness of the integuments, under which the axillary vein is immediately situated; if they are divided in a negligent manner, the vein will incur great danger of being opened, and cause a smart haemorrhage, perhaps phlebitis may be the consequence: the succeeding steps for denuding the artery will be most safely effected by a gentle unravelling of the cellular membrane with the handle of the knife, or a blunt probe.

Axillary Artery, immediately below the clavicle. The subject is partly to recline upon a table, with the shoulders slightly raised, in such a manner that the light will fall on the site of the operation; the arm having been elevated to a right angle with the trunk, the operator will

stand between it and the body, and commence his incision about half an inch external and below the sternal end of the clavicle, or at the point below the bone corresponding to the separation of the two origins of the sterno-mastoid muscle, and carry it with a gentle sweep outwards, to within an inch of the acromial end of the bone ; he will next dissect back the skin, and turn it up on the clavicle, by which the pectoralis major muscle and the white line of cellular membrane that intervenes between the sternal and clavicular portions of this muscle will be denuded ; the latter is to be divided in the same direction as the skin ; or he has it at his option to penetrate through the line just mentioned, and reflect it in the same way as the skin. The operator has by this means entered a triangular space, that is bounded superiorly by the clavicle, inferiorly by the divided portion of the pectoralis major, and externally by the tendon of the pectoralis minor ; the area of which is occupied by a fascia sometimes dense, at others weak ; however, it is always so strong as to require the knife to cut it, which is to be accomplished in the most guarded manner, by making a small aperture, and introducing a director under it, so as to divide it for the whole length of the wound. The axillary vein will be then seen imbedded in a quantity of lax cellular membrane, situated anterior to the artery which is concealed by it : at this period of the operation the arm ought to be

approximated towards the body, to relax the parts engaged in the operation, which will enable the surgeon to tease out the cellular tissue that connects the vein and artery to each other, with the handle of the knife or the end of a probe. After they have been separated, the vein is to be drawn downwards and inwards by a retractor, towards the chest, and the needle conveyed between it and the artery from above downwards, the convexity looking towards the clavicle. Such is the operation generally practised by British surgeons.—The vessel may be also found in a very ready manner, by adopting the following operation, which differs in nothing from the foregoing one but in the first incision, which is to be made upon the line that runs between the thoracic and clavicular portions of the pectoralis major muscle, and is easily seen in muscular subjects by throwing the muscle into action; the incision is to follow this guide from the clavicle for three inches, the line being exposed, and the two portions of the muscle separated from each other; the operation is to be finished as in the last. This method is advocated by the Continental surgeons.

In a full muscular subject, the first of these proceedings will give more satisfaction to the surgeon, as it allows him to form an extensive wound, (without any increase of pain to the patient,) and consequently more clearly to expose the deep-seated parts.

Relative Anatomy. The triangular space formed by the division of the pectoralis major may be termed the pectoro-clavicular, and is deserving of attention, as it contains parts of some importance besides the axillary artery. The area of it is filled up by the fascia already alluded to, which has been named the coraco-clavicular, or the costo-clavicular, according as it appears strongest at the external or internal side of the space which it covers. In almost every instance this membrane arises from the coracoid process of the scapula, then passes upwards under the pectoralis minor muscle to be attached to the under surface of the clavicle for the whole of its extent, from which it expands to the first and second ribs, sometimes so low as the third. This fascia will be observed to be always in immediate juxta-position with the axillary vein; from whence the necessity arises of using every precaution when opening it, to avoid injury to the vein, and more particularly so, as the knife must be employed to divide the membrane, in consequence of its great resistance. Vessels of some size pass through this space, which, if wounded, will not alone embarrass the surgeon by the hæmorrhage immediately supervening, but will also injure the collateral circulation. The first of these, the cephalic vein, crosses the external portion of this region, to empty itself into the subclavian, and is liable to be wounded when the cutaneous incision is carried too far outwards; but the most remarkable is a large artery, named the thoracica humeraria, or acromialis, that starts from under the upper edge of the pectoralis minor muscle, and emerges from between the axillary vessels, at the external side of the triangle. If this vessel is wounded, a smart hæmorrhage will follow, injecting the lax cellular tissue with blood, by which the remaining

steps of the operation will be rendered dangerous ; and in almost every instance considerable delay will attend the attempts to secure it, as it recedes under the protection of the lesser pectoral muscle ; in addition to this untoward circumstance, the vessel will be rendered useless as a means of establishing the collateral circulation, in which it holds an important place, since it sends many vessels to anastomose about the shoulder-joint, which assist in the function of the circulation, after the ligature on the axillary artery has been effected.

In this region, the vein, artery, and brachial plexus of nerves, have the following relative position to each other : the vein is situated most anterior, and inferior ; the artery is immediately posterior to it, and somewhat higher ; whilst the plexus is superior, and posterior to all. If the attention is directed to this arrangement, the vessel can scarcely be confounded with either of the other parts.

Observation. In the male and female subject a variety exists between the pectoralis major and minor, as regards the clavicle, which perhaps is not too trifling to be mentioned, and is due to the less degree of curvature of this bone in the latter than the former sex, in consequence of which the pectoralis minor is observed to run more parallel to it in the female than the male ; consequently, when the surgeon has divided the pectoralis major, he will perceive the superior edge of the pectoralis minor parallel to his incision. This ought to be kept in view at the time of operating, otherwise the latter muscle will be cut into, under the idea of its being a part of the great pectoral.

The position of the vessel is often the cause of delay, when the ligature is to be passed around it, being placed

at so great a depth from the surface, and the clavicle projects so far beyond it, that considerable impediments are offered to our attempts to insinuate the needle under the vessel. This is confessed by all surgeons to be one of the most difficult steps in the operation: from many trials on the dead subject, I feel satisfied that this object will be most readily attained, provided the needle be passed from above downwards, with its convexity in contact with the superior edge of the incision, consequently the point will look down into the axilla, and be made to appear between the artery and vein, at the same time that an assistant will draw the latter vessel towards the sternum.

If the needle is carried in the contrary direction, the point will be very liable to hitch against the pectoralis major, or the clavicle; and should the artery lie very deep, which it is always found to do in those whose pectoral muscles are much developed, the greatest difficulty will be experienced to bring the point of the needle out of the wound between the artery and clavicle, so as to seize the ligature, since the handle cannot be sufficiently depressed for this purpose, owing to the great resistance offered by the pectoral muscles. This step of the operation will always demand particular care from the surgeon.

Axillary Artery, as it lies under the tendon of the pectoralis minor muscle. To secure the vessel in this situation, the arm is to be extended and abducted from the trunk, which will indicate a hollow immediately below the clavicle, between the attachments of the deltoid and great pectoral muscle to that bone which conducts to the line

that separates these from each other; upon it, and from the clavicle, an incision of at least three inches in extent is to be made; the line being then exposed, and the cephalic vein protected, which runs in it, the muscles are next to be parted from each other, till the tendon of the lesser pectoral is seen, which is always recognized by its colour and course; a director is to be introduced under it, to allow the surgeon to divide it without any danger to the subjacent parts. The finger is then to be carried into the wound, the vessel freed from its connexions with the nerves, and included in the ligature.*

The principal difficulty in this operation, consists in insulating the artery from the brachial plexus of nerves, which, in the vicinity of the coracoid process of the scapula, entwine around it in a very complex way: this being overcome, the vessel can be easily secured, without any danger to the axillary vein, which lies internal to it. The operation may be subsequently injurious to the strength of the superior extremity, as one of the chief muscular attachments of the scapula to the trunk anteriorly, is destroyed.

The axillary artery can also be taken up where it is covered by the pectoralis minor, by sacrificing a portion of the great pectoral; for

* The vessel in this situation, was twice taken up successfully by M. Delpech, in cases of secondary haemorrhage after amputation.—*Vide Delpech, Clinique Chirurg. Montpellier, 1823.*

which purpose it will be necessary to extend the arm, so as to place the muscle upon the stretch, and make an incision through it transverse to the fibres; the divided portions will immediately retract, and a large deep cavity is presented to the operator, into which he passes the fingers upwards and inwards, to secure the vessel.

When the ligature is being conveyed under the vessel in the two last operations, it will be greatly facilitated if the arm be applied close to the trunk, which will be productive not alone of relaxation in the edges of the wound formed by the muscles being extended, but will also render the connexions between the artery, vein, and brachial plexus, equally free, so that the needle can be passed between them, and around the artery, with wonderful safety and despatch.

It is really astonishing the facility which is obtained by the last operation, to expose the artery in question; if the incisions be free, the vessel can actually be followed under the lesser pectoral, even as high as the clavicle; an open gaping wound is before the operator, who can see his work in a much clearer and more satisfactory manner than is afforded by the operation immediately below the clavicle, or that under the tendon of the pectoralis minor. In the living subject, from what my own experience has afforded me, I feel justified in stating, that no permanent injury will result from the great pec-

toral being cut transverse to the course of its fibres.

Of all the operations on the axillary artery, that immediately below the clavicle is the least eligible, nor indeed ought those which have been described as capable of being effected beneath the lesser pectoral be hastily adopted, provided the same advantages can be derived from the following one on the subclavian external to the scaleni muscles, which should always be preferred to any of the former, unless it be interdicted by some peculiar character in the disease, which will render it imperative to attempt the securing of the axillary vessel itself.*

Observations on the Anatomy of the Axilla. The axilla forms a cavity situated at the upper and lateral part of the thorax, between it and the internal surface of the humerus, of a conical figure, the apex of which is at the coracoid process of the scapula, while the base lies between the pectoralis major and latissimus dorsi muscles. It is bounded in the following manner: anteriorly by the pectoralis major; posteriorly by the latissimus dorsi and teres major; internally by the second, third, and fourth ribs, covered by a portion of the serratus magnus muscle; whilst externally the superior part of the humerus defines this region. All the nerves of the superior extremity, with the axillary vessels, pass through this cavity;

* The Reader is referred, for a confirmation of this opinion, to Professor Harrison's valuable work on the Anatomy of the Arteries, vol. i. p. 143.

the artery, during its course through it, gives off many important branches; besides numerous lymphatic glands are situated in it, and a considerable quantity of reticular cellular membrane, which modifies in a peculiar manner purulent collections, and the formation of aneurism in this situation.

The skin, when dissected from the base of the axilla, will expose the superficial fascia continuous with that of the pectoralis major; as it stretches over to the posterior border of this cavity, a thin but strong process is sent under the pectoral muscle, to be attached to the humerus. This process affords greater strength to the superficial fascia, and better enables it to answer the purposes intended, of supporting the deeper seated parts; when it is raised, a large vein is seen to ascend from the posterior part of the axilla, over the artery, and empty itself into the brachial, to assist in forming one of the principal roots of the axillary vein; not unfrequently another vein, of a large size, is observed to pass from the external side of the arm, also over the artery, and connect itself with one or other of the preceding vessels, in which case the axillary artery is then surrounded on three sides by large veins. These vascular relations are most frequently met with towards the inferior edge of the subscapularis muscle; the axillary vein, formed principally from the vessels just mentioned, is of considerable magnitude, and keeps in close contact with the anterior part of the artery, being more superficial than it: the student will be attentive to remark the connexions between these vessels, as they are always implicated in operations in this region.

The course, relations, and branches of the axillary artery, require to be studied with every possible care,

since they are in danger of being wounded in the different operations on the parent trunk, or in those that may be performed in the axilla for other purposes, such as the opening of abcesses, and the extirpation of tumours: though some of them are small, still, if they are divided, the loose reticular membrane will be instantly filled with blood, and the operation will consequently be much impeded. To expose the artery for the whole of its course, the subject ought to be placed upon the back, and the shoulders raised on a moderate sized block; after the skin, superficial fascia, and the pectoralis major muscle have been dissected from the anterior surface of the thorax, and laid over the arm, the vessel can be examined in the relations it has to the clavicle, coraco-clavicular ligament, and the pectoralis minor, also the connexions which the vein and brachial plexus present to it, and to see what arteries arise from it. When the pectoralis major muscle is replaced, it will be perceived, that the only muscular covering the artery has from leaving the clavicle to the pectoralis minor, is derived from the first of these muscles; it then passes under the tendon of the pectoralis minor, and having escaped from it, is again covered by the great pectoral for the remainder of its course. In addition to the coverings obtained from the muscles already mentioned, after the artery has emerged from beneath the clavicle, it is crossed by the anterior thoracic nerves, and is protected by the coraco-clavicular ligament. As the vessel descends to the arm, it touches the first layer of the intercostal muscles, the first and second indigitations of the serratus magnus anticus, connected to them by means of lax cellular membrane; it then passes over the subscapularis muscle, near to its insertion, and finally crosses the con-

joined tendons of the latissimus dorsi and teres major muscles ; from the thorax to the humerus, the vessel in its descent runs obliquely downwards and outwards, constantly approaching the latter.

The brachial plexus of nerves descend from the side of the neck under the clavicle, to be distributed to the arm ; in the commencement of their course they are situated superior and posterior to the axillary artery, and are connected to it by loose cellular tissue, until they arrive in the vicinity of the coracoid process, where they begin to surround the artery in that very intricate manner so remarkable in the parts under consideration, and continue this complex relation below the inferior edge of the conjoined tendons of the latissimus dorsi and teres major muscles.

The best idea of the anatomy of the axillary artery and its branches, will be obtained, if the pectoralis minor be allowed to remain *in situ*, which will divide the course of the vessel into three parts ; the first extends from the clavicle to the muscle, the second is covered by it, while the third is the remainder of the vessel. To each portion particular branches in general can be allotted ; for instance, from the superior third of the artery, arises the thoracica suprema, and sometimes the thoracica longior, or the external mammary of some Anatomists ; the first of these vessels is distributed to the parts about the sternal end of the clavicle, and ramifies its branches principally inwards towards the mesial line of the trunk, whilst the second descends under the pectoralis minor, to arrive at the inferior edge of the axillary cavity. The thoracica humeraria, or acromialis, is given off under the tendon of the lesser pectoral, from the middle third of the artery, and immediately winds above the superior

edge of the tendon, to be distributed to the two pectoral muscles, to the deltoid, and the shoulder; it is this vessel that is in such danger when the attempt is made to tie the axillary artery at the superior part of its course. From the inferior third we find a small vessel, named the thoracica alaris, which is often derived from the middle third of the parent trunk, and is destined to nourish the cellular membrane of the axilla, whilst, towards the termination of the artery, the subscapularis arises and courses along the inferior edge of the scapula, connected with many lymphatic glands; finally, the two circumflex arteries of the shoulder are the last that spring from the axillary.

In the axilla three sets of lymphatic glands are found; the first, or anterior, being situated along the edge of the pectoralis major; those of the second, or centre series, and but few in number, are scattered in the middle of that cavity, and are connected with the axillary vein; while the third set range along the edge of the subscapularis muscle, and hold intimate relations with the artery of the same name. These glands, when diseased and enlarged, in consequence of mammary and other affections, often require to be extirpated; as each of them is supplied with an artery and vein, and is imbedded in reticular cellular tissue, some precaution is necessary during their removal to prevent the parts being gorged with blood, which would interfere with the due performance of the operation. For which purpose, each gland is to be freed from the surrounding parts, being retained solely by the artery and vein, which are always enlarged in consequence of the previous disease; they are then to be tied, and cut across between the ligature and the gland.

This manœuvre will always prevent any hæmorrhage occurring.

When they are situated towards the superior border of the axilla, and penetrate into it, the axillary artery or vein is liable to be wounded during their extirpation ; if towards the posterior edge, the subscapularis artery is endangered, from which an alarming or fatal hæmorrhage may also ensue. Hence it is evident, when removing any of those enlarged glands, the operator is called on to proceed with the utmost caution and deliberation, and to have recourse to the knife as seldom as possible, indeed not at all, whenever he can break up their adhesions with the handle, or his fingers, so as to effect their removal.*

Abcesses occasionally point in the axilla, though their origin may be at the root of the neck ; since the nature of the cellular membrane is such in this region as to permit the matter to pass from its previous situation under the clavicle into it, in preference to penetrating the different layers of the cervical fascia. When such collections require to be discharged, the most prudent course to pursue will be to make an incision merely through the skin, then to use the probe or director, and endeavour, by means of it, to unravel the walls of the abcess, and so open into it, otherwise there will be considerable risk incurred of wounding any vein or artery that might lie anterior to it.

Aneurism often forms in this situation ; in the early stage, when very small, it can with difficulty be detected, so as to ascertain its true character ; after it has increased in size, the distinguishing characteristic of pulsation is sometimes absent ; the skin inflames over it,

* Surgical Anat. by A. Colles, p. 124, *et seq.*

and all the symptoms of an abcess are present, such as fluctuation, elongation of the skin, and pointing ; such cases have been punctured, under the impression of their containing matter, and fatal haemorrhage was the consequence.

I doubt much if such mistakes could now occur, as I have little hesitation in saying, that by means of the stethoscope a correct diagnosis would be obtained.

The Subclavian Artery, after having passed the scaleni muscles. The subject may be seated on a low chair, or so placed upon a table with the shoulders raised, that the light will fall directly on the neck, where the operation is to be performed. The operator may stand either before or behind the subject, and having directed the assistant to depress the shoulder forwards, commences the operation by making an incision from the external edge of the sterno-mastoid muscle, nearly to the anterior border of the trapezius, and parallel to the clavicle, by which the platysma myoides will be exposed, and is then to be divided to the same extent. If the first incision is made on the clavicle, as is recommended by some surgeons, these parts should be cut through at the same time, so as to form a narrow semilunar flap ; it is to be dissected from the bone, and reflected upon the side of the neck ; the external jugular vein is thus exposed, and if possible should be protected, which can only be effected when situated at either extremity of the incision to which it is to be drawn, and confided to the care of an assistant ; on the

contrary, when the vein runs in the centre of the incision, it will be necessary to tie two fine ligatures about it, and divide the vessel between them. The surgeon then proceeds cautiously to clear away the cellular tissue, and will also divide any remains of the superficial cervical fascia. Having cleared away the fat and cellular membrane, a mesh of veins may appear, upon which as little injury as possible is to be inflicted, while the omo-hyoid muscle will be seen to pass upwards along the posterior side of the wound, the operator is prevented going deeper by the existence of the deep cervical fascia, which is often so dense as to require the knife to lay it open ; this being done, he will pass his finger along the external edge of the scalenus anticus, behind which the artery will be found ; or the surgeon may look for the tubercle of the first rib, to which the muscle is inserted, and which is placed towards the anterior and internal part of the wound ; posterior to this eminence the vessel will be discovered, which is to be insulated from the surrounding parts, and included in a ligature, the aneurismal needle being conveyed from behind forwards. The reader is requested to peruse the *Observations*, p. 44, on this important step.

Relative Anatomy. The artery is situated in a triangular cavity, (which may be termed the omo-clavicular,) bounded superiorly by the omo-hyoid muscle, inferiorly by the clavicle, and internally it is defined by the scaleni, and the sterno-mastoid muscles. The

area of this triangle, besides the subclavian vessels, has scattered through it, from above downwards, numerous filaments from the cervical plexus of nerves; also the external jugular vein, a vessel generally formed of but one trunk; sometimes, however, it separates into two, three, or more minor ones, in the vicinity of the clavicle, which open separately into the subclavian vein: between the *two layers of the cervical fascia*, the omo-hyoid muscle is seen to ascend obliquely to its insertion. An acquaintance with the situation of this muscle is of the greatest importance to the operator, as, with very few exceptions, which will be noticed, it serves as a guide to the artery. I have often seen the omo-hyoid muscle run parallel to the clavicle for a considerable distance, and to be attached to the centre of that bone by a broad band of fascia, from which the muscle then ascended to the os hyoides.

Besides the subclavian artery and vein that pass along the clavicular side of this triangle, the transversalis humeri, or supra-scapular artery, runs outwards parallel to the clavicle, and partly under it; this vessel can scarcely be wounded in the operation, being protected by the bone; if any risk should be incurred, the artery can be drawn under the clavicle: the cervicalis superficialis also crosses this region higher up than the last mentioned vessel, which ought not to be injured, as it is sometimes very large, and supplies the base of the scapula; occasionally we perceive the transversalis colli at the very top of the omo-clavicular triangle. A great number of veins are observed to course through this space, from the scapula and root of the neck, to empty themselves into the subclavian; they form a kind of venous plexus, which, if opened, will embarrass the operator, by repeatedly fill-

ing the wound with blood ; the only way to avoid them will be by a careful and patient dissection.

The remaining important parts which the student is to attend to, are the brachial plexus ; they range along the posterior side of the triangle, and may be considered as forming a boundary to it ; they present a colour very similar to that of the artery, which may mislead the operator, consequently he will be attentive not to confound any of the nerves with the vessel : they are always placed superior and posterior to it.

Observations. Though no vessel in the system is so easily found as this artery, still, in Allen's System of Surgery, the following rule is given for ascertaining its position : " Draw a line from the sternal to the acromial end of the clavicle, and divide it into seven equal parts, three of which are to be allowed for the sternal end, and four for the acromial ; if a pin be passed through the point where these two divisions meet, it will transfix the vessel." I have verified this direction ; still there is no occasion for it.

For this operation the surgeon has the choice of three incisions ; the linear, the slightly convex, and the \perp shaped. He will find it best to commence the operation with the convex one, and if sufficient space be not afforded, it can readily be converted into the \perp form of incision, which will give ample room for the subsequent dissections ; as the shoulder is sometimes considerably elevated by the tumour, it will then be necessary from the commencement to have recourse to the last kind of incision, which will afford every facility to find the vessel. Before the operation is begun, two points of some consideration should be ascertained, namely, the course of the external jugular vein, and the depth of the artery ;

if pressure be made above the clavicle, the vein becomes turgid, and its direction immediately seen; if it be a large single trunk, few, if any, small vessels will be found in the line of the incisions; while, on the contrary, when it is small, and consists of two or more branches, the operation will be delayed by a number of small vessels which supply the place of larger trunks, and pour out blood according as they are wounded, to suppress which it may be necessary to have recourse to the ligature.

The depth at which the artery is situated from the surface will depend in a considerable degree on the size of the aneurismal tumour; if it be large, and does not descend into the axillary cavity, but ascends, the tumour will raise the clavicle with it, and in this way not alone increase the depth, but will also render the space very narrow, where the surgeon is to attempt the operation; the laborious respiration of the patient during the operation will also influence the deep position of the artery. On the dead subject a very instructive impression of this difficulty can be acquired, by keeping the shoulder elevated as much as possible when the operation is being performed; and must cause us to admire the dexterity of those gentlemen who have succeeded under such disadvantages in securing the vessel. The course of the omo-hyoid muscle is so generally found superior and posterior to the artery, that we feel confident it will be met with in this position, and conduct us to it. However, in a case of aneurism of this vessel, operated on a few years since by the late Mr. Todd, it is recorded that the muscle ran below the clavicle, from which situation he was obliged to dissect it, and bring it to the position it usually holds, before he could discover the artery.*

* *Vide Dublin Hospital Reports, vol. iii.*

The most difficult part of this operation does not always consist in denuding the vessel, but often the greatest embarrassment is experienced when the trial is made to convey the ligature under it; the best mode to effect this object will be to introduce the needle into the posterior part of the wound, towards the acromial angle, and make the point appear between the artery and the vein; if the opposite course be adopted, the perpendicular situation of the clavicle over the vessels will be some impediment to the needle passing first between them, at least without some difficulty; even were it easily accomplished, the bone, by its resistance, will always prevent the handle of the instrument that conveys the ligature being sufficiently depressed, so as to encircle the artery. In cases where the tumour is large, and the shoulder much elevated, it will be found to be the most arduous step of the operation. In such instances is it allowable to saw the clavicle to accomplish the end in view with facility? This practice is always exhibited in my Course on Operative Surgery; and when tried on a very fat subject, with the shoulder raised, as it is in aneurisms of great magnitude, the advantage that is derived from it can be only then appreciated. Is such practice, I again ask, justifiable on the living subject?—what additional injury is produced? A compound fracture of the clavicle is superadded, yet of the simplest kind, and inflicted in the least injurious manner, being effected by the division of the bone with a saw, and that in the most guarded way: such is the lesion; what is gained? The patient, in place of remaining on the table from an hour to an hour and a half, (which has often occurred when the tumour is large,) or even longer, during which pe-

riod he must suffer the greatest anxiety, may be only a fourth of that period under the operation, or even less, what a time saved: the vessel will be better secured, consequently less dread of haemorrhage, also the risk of wounding the subclavian vein will be much diminished; if recovery ensues, the bone will unite by ossific matter, even though union of this kind does not take place, we may rest confident that such a consolidation of parts will be obtained, as will allow of every ordinary use of the upper extremity after the operation.

It is necessary to state, that the late Mr. Todd was opposed to this practice. In a conversation which I had with him on the propriety of this innovation, he observed, it was suggested to him in his operation to saw the clavicle, the delay in passing the needle was so great; he was prevented from complying with this advice, fearing that it made a part of the aneurismal parietes, as it was actually buried in the tumour. He further remarked, from the success attendant on his operation, he did not conceive it was ever called for. Though condemned by so good an authority, I still throw it out for consideration. As this operation was first performed by Mr. Ramsden, it may be designated after him, to distinguish it from the two succeeding ones.

The Subclavian Artery, as it lies between the scaleni muscles. The subject being situated as in the preceding operation, the incision is to be commenced at the inner margin of the clavicular origin of the sterno-cleido-mastoid muscle, and prolonged outwards by the clavicle for at least three inches: after the skin, platysma myoides, and the superficial fascia have been penetrated,

if necessary, a director may be passed under the clavicular origin of the mastoid muscle, from without inwards, that it may be divided, which will facilitate the subsequent steps of the operation, particularly if the neck be fat and muscular; the cellular membrane is next to be unravelled, and whatever veins appear in the wound protected, until the deep cervical fascia and the scalenus anticus be exposed; after the former is cut through, a director is to be insinuated under the muscle, *from without inwards*, and with a probe-pointed bistoury the surgeon will detach it from the first rib for not more than the *two external thirds*; it will immediately retract, and uncover a considerable portion of the artery, round which a ligature is to be applied in the manner described in the last operation.

Relative Anatomy. The vessel in this part of its course is covered by the following parts, viz.: the integuments, platysma myoides, and superficial cervical fascia, also by the external origin of the mastoid muscle; subjacent to it, large veins often run parallel to the clavicle to join the internal jugular, which are to be avoided; the deep cervical fascia and the subclavian vein, partly concealed by the clavicle, next come into view, whilst the scalenus anticus is situated in the bottom of the wound, and is crossed by the supra-scapular and transversalis colli arteries, which are separated from it by the phrenic nerve, that descends on the fibres, and inclines towards the internal edge of the muscle; under these the subclavian will be found.

Observation. This operation is considered both difficult and dangerous by most surgeons; as it is conceived scarcely possible to avoid a wound of the phrenic (or great internal respiratory of Bell) nerve, which will seriously derange, if not arrest the function of respiration. This opinion was for some time entertained by myself; but from repeated dissections to ascertain the relations of this nerve, both to the muscle and artery, also how it is likely to be affected in the operation, and from often-repeated trials upon the dead subject, I am satisfied the operation can be performed without any injury being inflicted on this important nerve. The supra-scapular and transversalis colli arteries are, according to my judgment, as much endangered as the nerve: the first of these vessels can be defended by drawing it under the clavicle, while the second, as it pursues a course obliquely upwards and outwards, may be easily avoided by bearing this in mind. If the knife, when the scalenus is being divided, be properly managed, I will say, with only common attention, neither the nerve, the arteries already mentioned, nor the thyroid axis will ever be wounded, which is close to the inner edge of the muscle.

We are indebted to M. Dupuytren for suggesting this operation; the practicability of it he has successfully established on the living subject a few years since.*

The Right Subclavian Artery, before it passes the scaleni muscles. Having placed the subject as in the last operation, the student will begin the incision at the tracheal side of the sternomastoid muscle, and carry it outwards for at

* London Med. Phys. Journal, November 1826, p. 449.

least three inches, through the skin and platysma myoides; if he wishes, the superior lip of the wound may be cut through, by letting fall a perpendicular incision on it, of two inches in extent; these two will then represent a W inverted \perp , the flaps being dissected from the subjacent parts, and laid on the neck; a director is to be insinuated under the clavicular origin of the mastoid muscle, to allow of its safe division; the cellular membrane, and whatever veins appear in the bottom of the wound, are to be cautiously disposed of, and, if possible, without injury to the latter, till a fascia, the deep cervical, is exposed, which is to be penetrated by pinching it up in a forceps, to permit a small opening being made in it; a director is then to be passed under, and the membrane more extensively opened. The tracheal edge of the scalenus anticus muscle will be now seen; also the internal jugular vein, the eighth pair of nerves, and probably the common carotid artery, all being nearly on the same plane. By a prudent unravelling of the cellular membrane that connects these parts, the subclavian will be perceived in the fundus of this cavity, stretching towards the scaleni muscles and first rib, and encircled by the filaments of the great sympathetic nerve that go to form the circle of Vieussens.

If the carotid artery be exposed, it is to be drawn to the tracheal side of the incision, while the vein and nerves are to be carried to the acro-

mial end of it. As the subclavian gives off a number of considerable vessels close to the scaleni muscles, it will be necessary to trace it a little towards its origin, in order to apply the ligature nearer to the heart, than the points from whence these arteries spring; the needle ought to be conveyed under the artery, from the posterior or dorsal, to the anterior or clavicular aspect; while, from the intimate connexion, the subclavian has to the bag of the pleura, every precaution must be observed, that it is not injured during this proceeding; though a wound of the serous membrane does not necessarily prove fatal, it still would be productive of the most alarming distress.*

Second plan for performing this operation. After the superficial incisions, through the integuments have been made, one being parallel to the clavicle, so as to lay bare both origins of the sterno-cleido-mastoid muscle, and the second, descending for a couple of inches along the anterior edge of the same muscle; the operator will detach the entire of the sternal attachment, and a portion of the clavicular, from their respective bones, and turn them upwards and outwards on the neck; beneath this flap, some veins that descend from the thyroid gland are now exposed,

* Edin. Med. and Surg. Journal for 1815, for an account of this operation, where the pleura costalis was wounded.

and demand protection : the deep cervical fascia of Burn's, is next to be cut through on a director ; when the acromial edges of the sterno-hyoid and thyroid m. will appear, which are to be divided separately, and drawn inwards, the subjacent parts being protected by means of a director.

A little careful dissection will soon expose the common carotid, which is sometimes covered by fascia ; when it is opened, the vessel is to be traced down to the arteria innominata, where the sub-clavian will be found, and the ligature applied at a short distance from the innominata.

For reasons to be immediately mentioned, the carotid ought never to be solely depended on for finding this vessel.

Relative Anatomy. This vessel, according to the usual distribution, is the continued trunk of the arteria innominata, and ascends for a short space towards the first rib, where it runs horizontally outwards to penetrate between the scaleni muscles ; in this part of its course, it describes a slight curve, till it arrives at the bone just mentioned, whose concavity is in contact with the bag of the pleura costalis, and is situated towards the anterior part of the sac ; in this place, the vessel is covered by the common integuments, the platysma myoides, and superficial cervical fascia, also by the two origins of the sterno-mastoid muscle ; underneath them, the deep cervical fascia, and in some well-marked subjects the external edges of the sterno-hyoid, and thyroid muscles, conceal a very small part of the inner side of the vessel ; between the deep fascia and the mastoid muscle we often

observe a large vein to run, from the thyroid gland to the jugular or subclavian vein. The student may conceive, that too much importance has been paid to the fasciæ already mentioned; there is still another, which he will frequently find to present a firmer and denser structure than the deep cervical of Burns, and which passes on each side, from the centre line of the trachea outwards, immediately over the carotid and subclavian arteries. He cannot pay too much attention to these membranes, as, where ever found, they modify surgical operations in a very remarkable manner: beneath these fascia is the subclavian vein, which in the distended state, covers and conceals the artery, but in that of collapse, falls a little below it; while crossing anterior to the artery, are the following nerves: the eighth pair, the phrenic, and branches from the sympathetic, also, passing under it, are twigs from the same nerve, and the recurrent or inferior laryngeal. Before the subclavian artery arrives at the first rib, and scaleni muscles, it gives off the following important vessels: the vertebral, the internal mammary, the superior intercostal, and thyroid axis; the three last come off from nearly opposite points of the same circle of the artery, and close to the inner margin of the muscles, but the vertebral artery arises a little nearer to the heart, and is covered by the vein of the same name, as it issues from its canal to unite with the subclavian. From such an origin of the vessels, the necessity of applying the ligature at a short distance from the first rib, is immediately apparent to the student: if he places it between them, and that bone, the torrent of blood circulating close to the ligature will prevent the formation of an internal clot, which, though not absolutely necessary, is still an additional security against secondary hæmorrhage; though careful to avoid this di-

lemma, he should take care, not to fall into the opposite one, of carrying the ligature too close to the arteria innominata.

Observation. Surgeons have always experienced considerable difficulty in conveying the ligature round the artery, for which purpose various mechanical contrivances have been resorted to, each more complicated than the other. The student will find that he can easily establish this step, by using a common silver probe as an aneurismal needle, which will take any curve he wishes, being attentive to pass it from behind forwards, and not in the contrary direction, in consequence of the position the clavicle bears to the vessel, it will never allow the handle to be sufficiently depressed so as to bring the point of the needle under the artery; when performing this part of the operation, he ought also to remember that it must be done with the greatest gentleness, or the top of the pleura costalis will be penetrated, which will be productive of the most severe distress to the patient; perhaps marring the result of a well-planned, and executed operation.* Mr. Colles, one of

* The ingenuity of surgeons has been frequently exercised to invent an instrument that will facilitate the conveyance of the ligature about the arteries in deep situations. One of the most ingenious and perfect of these needles has been made by Surgeon L'Estrange of this city; it consists of a steel needle, less curved than ordinary, and possessed of two eyes, one anterior to the other; the curved portion of it is united to the remainder of the shaft, by means of a fine screw; the posterior eye being armed with the ligature, the needle is conveyed under the artery; as soon as it is perceived to have passed the vessel, in lieu of depressing the handle, which in some situations is nearly impracticable, a second instru-

the Professors of Surgery in the College of Surgeons in Ireland, was the first who attempted and succeeded in taking up the subclavian in this situation.—This operation, surgeons consider impracticable on the left subclavian, previous to its passing the scaleni muscles, for the following anatomical reasons, viz.: from its greater depth, the length of its course in the thorax, its turning suddenly over the first rib after emerging from that cavity, where it presents a length scarcely equal to the breadth of the ligature for securing it; the relations with the bag of the pleura costalis and top of the corresponding lung, are much more intimate on this than the opposite side, which render a wound of that membrane almost unavoidable. To those objections, ought to be added the parallelism of the course of the carotid artery and par vagum to the

ment, that terminates in a small hook, is passed to the fundus of the wound, and on the opposite side of the artery, so as to hitch in the anterior eye, when the shaft of the needle is unscrewed from that part which holds the ligature, and allows it to be drawn from under the vessel, by the second instrument; the ligature will be then found to encircle the artery.

I had lately a favourable opportunity of witnessing the application of this instrument in the hands of Mr. Porter, Surgeon to the Meath Hospital, in a case in which the subclavian was successfully secured by him, external to the scaleni muscles; the ligature was conveyed with great facility.

It is not so much on the vessel in this situation, as on the axillary below the clavicle, the subclavian internal to the scaleni, and the anteria innominata, that this instrument is so useful.

The Reader will find a variety of aneurismal needles represented in Cooper's First Lines on Surgery, under the article *Aneurism*.

subclavian, which endangers the enclosure of one or both in the same ligature, with the vessel we are desirous to secure; finally, the situation of the thoracic duct with regard to the artery; both run nearly parallel to each other, as they emerge from the chest; but as the duct descends to empty itself into the angle, formed by the union of the left subclavian and internal jugular veins, it passes anterior to the artery, and is in great danger of being wounded, during the dissection necessary to find the vessel, also from the very minute size of the duct, it can scarcely be seen, so as to exclude it from the ligature. When we consider the difference, in the coverings of the two subclavians, in this part of their course, we observe, that the left is more protected by the clavicle, also by the union of the internal jugular vein with the subclavian, which forms the vena innominata, and constitutes a large venous sinus, by which the vessel is completely covered; it is also concealed by the vertebral vein, which communicates with the sinus; and for nearly the entire of its course, from the aorta to the first rib, the left subclavian is overlaid by the top of the left lung. Such are the difficulties, the surgeon has to contend against, who attempts to take up the left subclavian, prior to its meeting the scaleni muscles. Though this operation be impracticable on the left subclavian, in this part of its course, there is no objection to the first and second operations being performed on it.

Irregular distribution of this vessel. The right subclavian presents some varieties as to its origin, and course, which are necessary to be remembered, otherwise considerable embarrassment, if not a total failure in the operation, will be the result: 1st, the right subcla-

vian may come off from the right side of the aorta, as a separate trunk; 2nd, it may rise from the top of the arch and pass behind the right carotid; 3rd, it may be given off from the left side of the aorta towards the termination of its curvature, and run either between the aorta and oesophagus, or between the latter tube, and the the dorsal vertebra, till it arrives at the first rib.*

In the first and second variety, I believe the vessel, though irregular as to its origin, still maintains its usual relations to the bag of the pleura, and to the other parts in the vicinity of the first rib, so that no unpleasant circumstances can occur from it during the operation; but the third variety, requires to be kept particularly in view, as the artery, where it is passing to the first rib, runs very deep, and will baffle every attempt of the surgeon to find it, unless previously aware of the situation of the vessel. I met with this irregular course a few winters back, and conceive it necessary to notice it in particular, as the relations of the vessel were totally different from those that it has in the ordinary course from the arteria innominata: after arising from the left side of the aorta, it ascended to the first rib, between the oesophagus and spine, in an oblique course, and in place of being on the top of the bag of the pleura costalis, and a little anterior to it, the vessel passed posterior to that membrane, and was so covered by it, as to be completely concealed from my view; another variety was observed in the same subject, which always accompanies the vascular irregularity: viz. there was no recurrent from the eighth pair of nerves on the right side; on examining for what supplied its place, I found

* *Vide Tiedman's Plates of the Arteries, Plate 11. 111.*

as the nerve descended along the neck, when opposite to the larynx, it sent off three branches nearly at right angles to supply that organ.* From the manner, in which the pleura costalis, covered the vessel in this instance, it appears to me, if such a disposition should be met with in the living subject, it would be impossible to secure the artery without wounding that membrane; from these varieties we are induced to recommend the rejection of the second plan of operating, as described at page 49, as, in cases of irregularity of this artery, or the carotid, it would lead to great delay, if not render it impossible to take it up. Under the head of irregular origin, may be mentioned that which accompanies the transposition of the viscera. In the Museum of the College of Surgeons there is a most interesting preparation of this kind, made by the late talented and ardent conservator, Mr. Shekleton, which also shows the transposition of the arteries that spring from the aortic arch; the right subclavian, in this instance presents all the relations to the surrounding parts, that the left does, in the usual distribution of the arteries, derived from that portion of the aorta.

Arteria Innominata. Desperate as this operation is, surgeons have for a long time contemplated it, for aneurism of the subclavian, or of the carotid at its root; no danger need be apprehended of the circulation of the right extremity, and side of the head, being prevented after

* A similar irregularity in this nerve has been described by Mr. Hart.—*Vide Edin. Med. and Surg. Journal for 1824.*

it is tied, since both the carotid and subclavian arteries have been found obliterated, still the superior extremity, and brain, were well supplied with blood: these pathological proofs, as every person conversant with arterial injections, is aware, are corroborated by the facility, with which even coarse injection will pass from the aorta through the left carotid, and subclavian to the right side of the head and neck, after the arteria innominata has been tied.

The patient being so placed upon a table, with the shoulders raised, as to allow the light to fall upon the root of the neck, and the head thrown as far back as possible, which will elongate the vessel, and draw it up from the thorax; the student will make an incision from the centre point of the neck immediately above the sternum outwards, for three inches, across the attachments of the sterno-mastoid muscle; this is to be converted into an L shape, by a second incision being made along the anterior edge of the sterno-mastoid muscle, till it meets the internal end of the first; the skin, platysma myoides, and superficial cervical fascia being divided, the sternal origin of the sterno-mastoid muscle, with a part of the clavicular, will be exposed; under these a director is to be passed, to allow of their being detached with safety to the subjacent parts, from their attachments, and thrown outwards on the root of the neck; the deep cervical fascia, with the external edges of the sterno-

hyoid and thyroid muscles, and some veins from the thyroid gland, are next seen in the bottom of this cavity ; the muscles are to be divided separately, and with every precaution, upon a director which will defend the subjacent parts ; though these will retract, still they ought to be drawn by means of a retractor to the inner side of the wound, by which the carotid artery, eighth pair of nerves, and internal jugular vein, will be better exposed, and consequently protected from injury : the carotid artery is then to be traced to its origin, which, if regular, will conduct to the arteria innominata ; under it the ligature is to be passed, from behind forwards.

Relative Anatomy. This vessel arises from that part of the arch of the aorta, where the ascending joins the transverse one, and ascends as high as the sterno-clavicular articulation of the right side ; being about an inch and a half long, seldom it exceeds that length, and divides into the common carotid and subclavian vessels ; anteriorly, it is crossed by the vena innominata of the left side, near the aorta, which not unfrequently receives veins that descend from the right side of the neck, and pass over the artery ; while superiorly the sterno-hyoid and thyroid muscles cover it, and a quantity of cellular membrane, the remains of the thymus gland ; if the student will search, he will find the superficialis cordis nerve descending to the heart, between the artery and vein ; posteriorly, the innominata lies on a small part of the trachea ; to the right of it, is the vena innominata of that side, also the pleura costalis, assisting to form a part of the anterior mediastinum ; on this side the eighth pair

of nerves will be also found, in connexion with the vessel, but a little posterior and external to it.

In some instances, I have seen the arteria innomina to ascend above the sterno-clavicular articulation, before it divided; it occasionally passes on the trachea for a greater length than is usual; both these points are worthy of recollection, as regards this operation, also that for tracheotomy.

Observation. This operation is not of difficult performance on the dead subject; where, by position, the parts can be easily drawn from under protection of the clavicle, and no impediment is experienced from hurried and laborious respiration. In the living subject, I apprehend it would be far different, as such a posture could not long be endured, from the great distress it would cause to the patient; in addition, the laborious respiration, by inducing the veins to become turgid, would not alone embarrass the operator, but also expose them to imminent danger of being wounded; while, from the proximity of the artery to the pleura, that membrane will incur considerable risk of being injured, though the gentlest efforts be used to free the adhesions between it and the vessel, to allow of the ligature being passed round it.

These difficulties would be much increased, if the aneurismal tumour encroached on the tracheal side of the scaleni muscles, as the operator would be compelled to make his dissection, in a comparatively deep and narrow cavity.

If we rely on the carotid, to conduct us to the vessel, we must not lose sight of the irregularities to which the vessels in this region are subject; when passing the ligature, too great care cannot be taken to protect the im-

portant parts among which it is to penetrate. This will be best accomplished, by using the needle already mentioned at page 52 ; and here let me impress on the young operator, the risk he will run, should he employ any of those instruments which are worked by means of a spring, as in general, they do not play very freely in their sheaths, and should any unfortunate jerk, or a too rapid motion take place, when attempting to pass it, in all probability the pleura, or some large vein, will be wounded.

Hazardous as this operation undoubtedly is, there are two well authenticated cases on record of its performance ; the first by Dr. Mott of New York, in 1818, the second by M. Graëfe of Berlin, in 1822.

Dr. Mott was induced to take up the vessel secondarily, the operation being intended to secure the sub-clavian before it reached the scaleni ; when that vessel was exposed, it was considered to be diseased, and unable to bear the effects of a ligature ; he therefore traced it to the arteria innominata, and secured that vessel. In the account published in the American edition of Burn's Anatomy of the Head and Neck, edited by Mr. Pattison, it seems, that no great difficulty was experienced in passing the ligature under the vessel : during the dissection which was necessary to expose the artery, and which was partly effected with the smooth handle of an ivory scalpel, a branch of an artery was wounded, which yielded for a few minutes a very smart hæmorrhage, so as to fill the wound six or eight times ; it was about half an inch distant from the innominata, and from the stream admitted was about the size of a crow quill ; it stopped with little pressure. Dr. Mott scarcely thinks that it could have been the internal mammary artery, from the hæmorrhage ceasing so

quickly, though, from its situation, it would appear to be it; if, from some irregularity, it was not the superior intercostal, it must be some anomalous vessel.

I have in one instance, seen the internal mammary, to arise from the subclavian, external to the scaleni muscles, and cross before the anticus, to arrive at the inner side, and then descend into the thorax; had this irregularity occurred on the right side, it would have been endangered in this operation. Meckel remarks, that the internal mammary sometimes springs from the arteria innominata, occasionally, from the arch of the aorta. Dr. Mott expresses his feelings in the following language, when about to tie the ligature:

"In no instance did I ever view the countenance of man with more fluctuations of hope and fear, than in drawing the ligature upon this artery. To intercept suddenly one-fourth quantity of blood so near to the heart, without producing some unpleasant effect, no surgeon, *a priori*, would have believed possible. I therefore drew the ligature gradually, and with my eyes fixed upon his face; I was determined to move it off instantly, if any alarming symptoms had appeared. But instead of this, when he showed no change of feature or agitation of body, my gratification was of the highest kind. Dr. Post now asked him if he felt any unpleasant sensation about his head, breast, or arm, or felt any way different from common? to which he replied, that he did not. Immediately after the ligature was drawn tight, the tumour was reduced in size about one-third, and the course of the clavicle could be distinctly felt."

The ligature, came away on the fourteenth day, the patient having lived till the twenty-sixth, during which period, every thing announced that the collateral circula-

tion was sufficient, for the support of the right side of the head, neck, and upper extremity; no mental alteration whatever having been experienced. The editor of the American edition of the work alluded to, imputes (and with every degree of probability) the secondary haemorrhage, which proved fatal to the man, to too much of the artery having been denuded, thereby, destroying a great number of the *vasa vasorum*, which prevented the sanguineous process of the adhesive inflammation taking place.

M. Graëfe, in his case of ligature on the arteria innominata, was conducted to it, by tracing the carotid to its origin; his patient survived the operation, sixty-seven days.

It is mentioned at page 58, that the carotid artery is considered a certain indication to the arteria innominata, if the latter exists. However, from the irregularities described in the preceding page, 55, it appears to me, the surgeon, should never solely confide on the carotid for finding the vessel, but ought to look directly for it; in other terms, he ought to conduct his operation, as to search directly for the vessel that maintains the disease.

The Primitive Carotid Artery. Many cases derived from pathological investigations* were known to surgeons, of the obliteration of this vessel, without any sinister effects being produced on the brain, before they ventured to tie it, in the human subject. Accident first led to its being secured to arrest haemorrhage; and to Sir A. Cooper, is due the merit of being the first

* *Vide Haller, Pelletan, Petit, Baillie.*

who placed a ligature on it for aneurism, according to Mr. Hunter's principles, for the treatment of that disease.

This vessel is now unhesitatingly tied, to prevent bleeding from itself, or from any of the large branches, whether caused by direct violence, or from their being laid open, by the ravages of ulceration, extending to them from other organs, also for aneurism, and aneurism by anastomoses.

This vessel can be taken up in any part of its course, after it has emerged from the thorax, to its bifurcation : from the relations which it has to the omo-hyoid muscle, the operation can be divided, 1st, into the one below this muscle, and, 2nd, the one above it ; the latter, is always to be preferred when the case will admit of it.

The operation below the omo-hyoid Muscle.
Let the subject be so placed, that the light will fall on the root of the neck, with the head turned to the side, opposite to the one, on which the operation is to be performed ; this position, will define the anterior edge of the sterno-cleido-mastoid muscle, that serves as a guide for the external incision, which should commence immediately above the sternum, and pass upwards, parallel to the anterior edge of the muscle, for about three inches ; dividing the skin, superficial fascia, and platysma myoides muscle, the edge of the sterno-mastoid will be then exposed ; it is to be drawn to the external side of the inci-

sion, when a large vein, will be often found, to descend from the thyroid gland to the internal jugular; it may be protected by carrying it in the same direction with the muscles; the deep cervical fascia being next exposed and divided, the sterno-hyoid, and thyroid muscles will appear, which are to be drawn towards the trachea, with some branches of the descendens noni nerve; however, should the muscles be found to overlap the artery, it will be prudent to divide each of them, in succession upon a director, for at least half or two-thirds of their breadth.

By their retraction, aided by being also carried to the tracheal side of the incisions, the sheath of the carotid will be satisfactorily seen, which being opened cautiously, for the extent of half an inch or less, the internal jugular vein will be perceived external, and on the same plane with the artery; these being separated from each other, and the neck gently curved forwards, the ligature is to be passed from without inwards, being attentive to preserve the eighth pair of nerves; it lies posterior and a little outside of the artery.

In Sabatier's Medicine Operatoire, we are recommended for this operation, to cut between the two origins of the sterno-mastoid muscle, and endeavour to find the vessel as it issues from the thorax; this is not a bad direction for the incision, still it conducts us more on the vein than the artery; by attention to this

precaution, there is no great objection to adopt it.

The Carotid above the omo-hyoid muscle. The patient being similarly situated as in the preceding operation, the inferior edge, of the thyroid cartilage, will point out the place where the incision is to commence, which is to be prolonged upwards for about two inches, along the anterior edge of the sterno-cleido mastoid muscle, through the skin and superficial fascia; the platysma myoides being laid bare, it is to be also divided to the same extent as the first incision; the sterno-mastoid is then to be drawn a little outwards, when the sheath of the vessels, will be found, immediately above the omo-hyoid muscle, having anterior to it the descendens noni nerve, which in this part of its course is to be drawn to the same side with the sterno-mastoid muscle; all that remains to be done, is to open the sheath, and pass the needle from without inwards.

The *external carotid*, may be easily exposed, till it reaches the tendon of the digastric muscle, by extending the incision of the last operation upwards, towards the mastoid process, when a ligature may be passed round it, half an inch from the bifurcation of the trunk.

Relative Anatomy. The carotid arteries, after issuing from the thorax, ascend till they arrive between the superior edge of the thyroid cartilage, and the os hyoides, where they divide, into the internal and external

branches ; in this course, the two carotids diverge a little from each other, at the sides of the thyroid cartilage, from its being wider than any other portion of the trachea ; for nearly the inferior half of the neck, the vessels are covered by the common integuments, the two layers of the cervical fascia, and the platysma myoides muscle, also by the sterno-mastoid, hyoid, and thyroid muscles, and by some of the branches of the descendens noni, that are distributed to the two last ; after they have ascended above the sterno-hyoid and thyroid muscles, the omo-hyoid, passes anterior to them, and having escaped from it, they are then, merely covered by the integuments platysma myoides, the cervical fascia, and some veins that descend along the edge of the mastoid muscle ; the descendens noni nerve generally courses down the neck, anterior to the sheath of the vessels ; sometimes it is contained in it, and, occasionally, the nerve is situated posterior to the sheath and the vessels, while the numerous nervous filaments, from the cervical plexus, run anterior to them to the centre of the neck.

Internal to each carotid, the trachea, œsophagus, thyroid gland, which not unfrequently lies in part anterior to them, and the thyroid cartilage, are situated ; while the internal jugular vein, accompanies its respective artery at the external side. On examining the relations of these vessels posteriorly, they will be found in their ascent to pass anterior to the inferior or recurrent laryngeal nerve, over the inferior thyroid artery, and somewhat higher in their course over the superior laryngeal nerve, while the eighth pair, descends the neck posterior, but in the sheath of the carotid : finally, the great sympathetic is the most posterior of these important parts, in relation to the artery, and is supported by the muscles that

lie on the cervical vertebrae. From the thorax, to the omo-hyoid muscle, the right, and left carotid, do not present the same relations to the surrounding parts, which they do, to those when above it, and which it is requisite to be known, to prevent any embarrassment in the operation; *e. g.* the right carotid is more superficial, and runs nearer to the median line of the neck; it is also in more intimate contact with the trachea, indeed partly lies upon it, and is consequently supposed to incur greater danger of being wounded than the left, in operations on that tube, particularly if the attempt to open it be carelessly made. The left carotid, is not alone at a greater depth than the one on the opposite side, but is intimately connected to the oesophagus; it is also concealed by the internal jugular vein, which passes partly anterior to the artery to join the subclavian, so as to form the left vena innominata: added to these, the thoracic duct ascends from the pectoral cavity, posterior and parallel to this vessel, to communicate with the vein.

Observation. As a general rule, the anterior edge, of the sterno-mastoid muscle, may be considered one of the best guides to conduct to this vessel, through the entire of its course. M. Burns gives the following rule for finding it at the superior part of the neck:—" draw a line from the anterior part of the mastoid process to the centre of the upper bone of the sternum, and another from the side of the body of the os-hyoides, to a little nearer the sternum than the central part of the clavicle, the artery will be found at the point of decussation of the two lines, and a line passing from that point up to the angle of the jaw will indicate its course."*

* *Vide* Burns' Anat. of the Head and Neck.

There is scarcely any necessity for such a rule, as the direction of the edge of the muscle will be sufficient for every practical purpose; when the operation, is being performed for securing this vessel, many branches of the cervical plexus must be divided, and numerous veins of a large size will be met with, which appear trifling and of no importance in the dead subject, but when opened in the living, will cause much annoyance; to prevent such an untoward occurrence, the handle of the knife, should in general be employed, to separate the cellular membrane after the integuments have been divided.

The internal jugular vein is frequently described to swell during the laborious attempts to respire, which the patient makes at the time of the operation being performed, and to overlap the vessel, so as to impede the necessary steps for exposing it. My friend, Mr. Read, informs me, in all the operations he performed, or assisted in, on this vessel, the vein was not found to interfere with the operation, nor was it even seen: however, should it be in the way, it can easily, by means of a retractor, be drawn to the outer side of the wound, or it may be so managed, that pressure on the vein at each angle of the incision, will prevent it filling, and, consequently, obviate any embarrassment likely to ensue from becoming turgid.

In most instances, if the sheath is opened near the centre, or over the artery, the vein will scarcely ever cause any annoyance to the operator. When the carotid is wounded in very thin people, the hæmorrhage may be arrested by applying pressure along its course; but in strong, robust subjects, the only mode of effecting this will be, to thrust the fingers into the wound, and apply

pressure directly on the cut-extremity of the vessel, till it can be secured.

The student, has doubtless remarked the frequent repetition of the injunction to destroy the cellular connections of the different parts, by laceration ; however, from what is mentioned below, he ought to be prepared for inflammatory attacks supervening to it, when he acts in this manner.* Some irregularities in the origin of the arteries, at the lower region of the neck, are occasionally met with, which must not be overlooked ; in two instances in the adult.

I found the vertebral, in place of passing into its osseous canal, between the sixth and seventh cervical vertebra, ascending the neck, parallel to the carotid artery, which it equalled in size, and entering a foramen presented to it by the third cervical vertebra. Where such

* When in Paris in the winter of 1824, I saw M. Duputryen take up the carotid, above the omo-hyoid muscle, in a female above eighty years old : for the first five or six days every thing promised success, at which period she was seized with pain in the wound, and dysphagia ; these were successfully combated, by leeching and purgatives, and subdued for a time ; they recurred, similar means were put in practice, but in vain : about the fifteenth day after the operation she died ; the *post mortem* examination of the wound shewed that no part was injured but what was absolutely necessary ; but from the incision a chain of abscesses was found, extending into the posterior mediastinum, which destroyed the patient by the irritation they induced, and whose formation this celebrated Surgeon attributed to the injury inflicted on the cellular membrane, by tearing rather than dividing it with the knife ; this laceration was rendered necessary in consequence of the great number of veins that he found passing through the wound.

an irregularity exists, the vessel might readily be confounded with the carotid; in the cases to which I allude, the vertebral ran a little posterior and external to it; owing to the irregularity in the eighth pair of nerves, (*vide page 55,*) the operator, ought to be careful not to carry his knife so deep as to be posterior to the vessel; when such a variety is present, great danger would be incurred, of wounding some of the branches which supply the larynx, and so produce great derangement of the voice; this observation, bears particularly on the operation above the omo-hyoid muscle. The operation of including the carotid in a ligature, at the distal side of an aneurismal sac, has been alluded to at pages 9, 10, and it now remains to state the reasons that justify such a proceeding; this vessel, possesses an advantage for such practice, that no other artery in the system does; namely, of running for a considerable length without giving off any branch; it is also very seldom the seat of an irregular distribution. This unity of the vessel, (if it may be so named,) insures us against the danger of the disease, being maintained after the ligature has been applied, by the blood, circulating first along the vessel, then through the tumour, and finally passing off by a branch that may intervene between the ligature and the sac, as may be the case in any other artery but the one under consideration; and which, in all probability, by maintaining the blood in the aneurism fluid, would favour its increase.

At the period, when the cases in support of the revival of the operation in question were made known to the public, and which were tried, not alone on the carotid, but also on the subclavian, the prospects, as to their favourable termination, were most encouraging; since then,

opportunities have been afforded to investigate the results by *post mortem* examinations, which have not been as satisfactory as the operation in the first instance promised.

Before concluding our descriptions of the operations, on the arteries of the superior portion of the trunk, two remain to be described, which Surgeons deem necessary, in order either to prevent haemorrhage, or to repress morbid growths ; thus, in the extirpation of large portions of the tongue in case of cancer, the lingual artery may be secured as a preparatory step ; while in goitre or bronchocele, the superior thyroid, has been tied with considerable benefit to the individual.

Lingual Artery. The origin and course of this vessel, are so regular, that we can always dissect down to it with a certainty of finding it ; the subject being seated on a chair, with the head turned to the opposite side, and the student standing in front, will ascertain the situation of the great cornua of the os-byoides, which is to be the centre of the incision, and will commence it, a little below the symphysis menti, and carry it obliquely downwards and outwards, anterior to the part of the os-hyoides already mentioned, till it meets the sterno-mastoid muscle ; the skin, superficial cervical fascia, and platysma-myoides being divided ; he will dissect cautiously, till the tendon of the digastric muscle appears, and continue the dissection, to expose the hyoglossus or ninth pair of nerves, which is seen

to run towards the mesial line of the neck, subjacent to it, and a little below; he will find the artery, taking a similar course with the nerve, and will insulate it from the surrounding parts to pass a ligature under it.

Relative Anatomy. This vessel constitutes the second artery that comes off from the anterior aspect of the external carotid; it generally arises by a single trunk, but sometimes, in common with the external maxillary or fascial artery, its course at first is horizontally inwards, upon the middle constrictor of the pharynx, till it meets the great cornua of the os-hyoides, after which, it ascends, and finally assumes the direction it had at the commencement of its course, the only place in which it can be taken up.

In the dissection, to secure the lingual artery, the operator, will attend to the order and course of the different parts, that it will expose for him, to be confident that he is in the proper direction; after the superficial structures have been penetrated by a little dissection, the tendon of the digastric muscle appears of a shining and white colour, and passes horizontally inwards, deeper seated than it, and a little inferior, the ninth pair of nerves will be seen, of the same colour, but not so brilliant an aspect; while still deeper placed, and below the nerve, the artery lies upon the middle constrictor muscle, and preserves the same course at the digastric tendon. It is imperative, to pay strict attention, to the colour and order of superposition, of these parts, or one of them will be readily taken for the other.

Superior Thyroid Artery. For the purpose of securing this vessel, the patient is placed as in the operation for taking up the carotid, above the omo-hyoid muscle, and the incision is to take the same course, as if it was intended to tie the latter vessel; by a careful dissection, the sheath of the carotid artery will be exposed, and is to be drawn outwards; on its internal side, the thyroid artery will be found passing downwards and inwards to the gland, from whence it derives its name, it is to be then separated from the surrounding parts, and included in a ligature, a short distance from its origin.*

Relative Anatomy. This artery is covered by the same parts as the carotid, but lies somewhat deeper; it has nearly parallel and posterior to it, the superior laryngeal nerve.

The Inferior Thyroid Artery. Can also be secured, for the purpose of preventing the supply of blood to the thyroid gland; for which purpose, the patient should be situated as in the operation for the carotid, below the omo-hyoid muscle; and the incisions ought to run in the same line as for that vessel, until the sheath of the carotid and internal jugular vein is exposed; it is to be drawn to the external side of the incision, whereby the bodies of the cervical vertebra can

* *Vide* Earle for the advantage resulting from this operation in bronchocele.

be recognised ; when, by a careful examination, the artery will be found passing inwards to the inferior part of the gland, opposite to the fifth, sometimes as high as the fourth cervical vertebra, and then is to be included in the ligature.

Relative Anatomy. This artery is the largest of the branches that come off from the thyroid axis, and ascends along the neck, resting on the scalenus anticus muscle till it arrives at the fifth cervical vertebra, when it curves inwards, running under the carotid artery and great sympathetic nerve to arrive at its destination ; as it enters the gland, it is crossed by the recurrent or inferior laryngeal nerve.

When performing the operations for securing the three last-mentioned vessels, the surgeon is liable to similar embarrassments as occur in the operations on the larger vessels in the neck, (I allude to veins and hæmorrhage from them,) to which may be added the greater want of regularity in the courses of the former than of the latter, as well as, that they are situated at a greater depth ; however, by attention to the preceding directions, there is not the least doubt but the vessels can be found, aided by care and a little patience.

CHAPTER III.

OPERATIONS ON THE ARTERIES OF THE INFERIOR EXTREMITIES.

DORSALIS PEDIS. After the foot has been extended on the leg and firmly supported, the incision may be commenced, a little external to the tendon, of the extensor proprius pollicis pedis, or on a line, that will pass from the base of the metatarsal bone of the second toe, to the centre of the ankle joint; after the division of the integuments and superficial fascia, the vessel will be found between the tendons of the above-named muscle, and the first of the extensor digitorum brevis: sometimes a small branch of the tibialis anticus nerve lies anterior to it; generally this is on its external side, and is to be excluded from the ligature. When the cutaneous incision is being made, some of the terminating branches of the fibular nerve are endangered.

Observation. This vessel occasionally takes a circuitous route, to arrive at the space between the phalangar terminations of the first and second metatarsal bones,

after having passed under the annular ligament of the ankle, it runs downwards and outwards under the belly of the extensor digitorum brevis, and does not approach the tendon of the extensor pollicis pedis, till it is half an inch from the point, where it anastomoses with the external plantar artery, by diving to the sole of the foot between the first and second metatarsal bones.

Anterior tibial Artery, in the upper third of the Leg. The leg being properly supported ; upon a line that extends from the mid point, between the tuberosity of the tibia and the head of the fibula, to the centre of the ankle joint, the student will commence the operation, and carry the incision downwards for at least five inches ; or he may begin the operation, so low as the inferior fourth of the leg, about half an inch external to the spine of the tibia, from which point it is to be prolonged upwards and outwards, so as to terminate superiorly about one or one and a half inch from the spine of the bone. After the division of the skin, the dense fascia of the leg is exposed, which he will cut through to the same extent as the integuments ; then into the first intermuscular space, that is found, as he proceeds from the tibia to the fibula ; which can always be rendered apparent by extending and flexing the foot. The operator will pass his finger, or the handle of the scalpel, and separate the muscles from each other to bring into view the interosseous ligament. When the artery will be found on the ligament, having the

anterior tibial nerve to its external side ; the extensor muscles of the foot being relaxed, and the wound dilated, the ligature can be passed round the vessel with ease.

Relative Anatomy. This vessel, after having passed through the interosseous ligament, lies very deep, but becomes more superficial as it descends along the leg, being thrown forwards by the tibia, which enlarges inferiorly, to form the internal malleolus, and to allow a cavity for the purpose of lodging the os astragulus. For the upper third of the leg, the artery is situated between the tibialis anticus, and the extensor digitorum communis muscles, with its accompanying nerve to the outside, and surrounded by veins, while for the two inferior thirds of the leg, it runs between the tibialis anticus and extensor proprius pol. pedis, m. The nerve for the upper part of this space passes anterior to the vessel, in order to arrive at its internal side, where it continues for the remainder of its course.

Observation. As most of the muscles on the anterior part of the leg are of a pyramidal shape, with their bases situated superiorly and their apices inferiorly, our great object should be, to make the incision run parallel to the line presented by such an arrangement, which will invariably conduct us to the intermuscular space. By recollecting this form of the muscles, it is indifferent whether the incision be commenced above or below, provided such a direction be given to it, as will correspond to the line of the muscles. When searching for this vessel, at the superior part of the limb, it will be necessary to make the incisions of the length already indicated, to allow the subjacent fascia to be freely divided, which op-

poses so much resistance, that if this precaution is neglected the surgeon will be scarce able to expose the vessel, particularly in a full, muscular limb, when incisions of but two, or three inches long are made.

In some cases, a peculiar irregularity in the distribution of the anterior tibial is observed, namely, to be expended at the middle of the leg, while the remainder of its course is supplied by the peroneal or fibular artery, which penetrates the interosseous ligament, where the tibial vessel terminates.

The line of incision, already alluded to will enable the operator to secure the ant. tibial artery, at the inferior part of the leg, where he will find the vessel always more superficial, in consequence of the tibia throwing it forwards upon which it runs.

The Posterior Tibial Artery, as it runs behind the internal Ankle. Having placed the subject in the recumbent position, and extended the leg, an incision is to be made about two inches long, whose centre is opposite to the ankle, and a little external, about quarter or half an inch, through the skin and fascia, the vessel will be then found, and is to be included in a ligature.

A more certain mode of exposing this artery, will be to cut from the inner ankle towards the tendo Achillis, and divide the skin and superficial fascia; the fascia, which binds down the deep-seated muscles, being penetrated, the tendons and other parts that lie posterior to this osseous process, will be laid bare, and as the opera-

tor proceeds to the tendo Achillis, he will meet the vessel. During this operation, the leg ought to lie on the external side.

Relative Anatomy. As we pass from the internal ankle to the tendo Achillis, the following order is observed to exist in the situation of the parts : the tendon of the flexor digitorum communis muscle is first seen, covering that of the tibialis posticus, which rests immediately on the bone. At a very short distance from these is the artery, accompanied by two veins, then the posterior tibial nerve, next the tendon of the flexor proprius pol. pedis, will be recognised ; finally the tendo Achillis presents itself.

Posterior Tibial Artery, in the middle of the Leg. To perform this operation the subject is to be placed in the horizontal position, with the leg laid on the external side, and extended, when an incision of from five to six inches long, is to pass parallel to the internal angle of the tibia, and a little posterior to it, (quarter of an inch,) through the integuments and superficial fascia, the gastrocnemius being drawn outwards, and the attachment of the solæus being laid bare ; it will be requisite to divide it, of equal extent with the cutaneous incision ; the deep aponeurosis of the leg, placed in the interosseus space covering the three deep muscles, is next to be freely opened ; and if the leg be flexed after this section of the soft parts, the fingers may, with facility, penetrate to the centre of it, in which situation the vessel will be found on the tibialis posticus.

muscle, and is to be enclosed in the ligature passed around it, from without inwards, to avoid the nerve.

Relative Anatomy. This vessel, as it descends along the leg, lies on the flexor muscles of the foot, and is covered by the deep fascia that passes from the tibia to the fibula ; at the upper fourth of the leg, the posterior tibial nerve is internal to it, while for the remaining fourths, it is always situated to the external side of the artery. In the integuments some of the large branches of the saphena major vena often course in the superficial incisions.

Observation. On the dead subject, this operation is of easy performance, but on the living frequently it is found quite the contrary ; as the artery is placed at a considerable distance from the surface, particularly if the limb be large ; it is also bound down by a strong fascia ; and the difficulty is often augmented by the muscles being affected with spasm ; (they are also rigid and unyielding, and when the fascia which covers them is divided, they leave their natural position and become much elevated, so as to make the situation of the artery appear as a deep cavity, at the bottom of which the vessel is placed ; *Harrison*;) which, in addition to what has been already mentioned, so much embarrasses the operator, as almost to prevent his being able satisfactorily to find the vessel, and compels him to trust to chance to secure the artery, by plunging a needle in the direction it runs.

The most certain means of success, will be, to have the incisions of sufficient extent, which alone will enable us to gain room without much traction of the soft parts, which may induce spasm after they are completed, and to

take advantage of posture, *i. e.* by flexing the foot on the leg, and the latter on the thigh.

From the great difficulty sometimes experienced in securing this vessel, caused in many cases by spasm, is it allowable, after the cutaneous incision, to make a small perpendicular one in the solæus muscle? On the dead subject this expedites the subsequent steps of the operation in an extraordinary degree.

In some fat and muscular subjects, when the muscles of the calf of the leg have been separated from the deep-seated ones, a quantity of firm granular adipose substance will be often found in the centre of the limb, in the midst of which the vessel is situated, similar to the manner that the coronary arteries of the heart, are placed in the fat on that viscus.

The Posterior Tibial Artery, in the upper third of the Leg. In this situation, or even nearer to its origin, the artery can be secured if necessary; the limb being extended on the thigh, the surgeon will mark the course of the vessel, which coincides with a line that will pass from the centre of the popliteal space to the mid point between the internal ankle and the tendo Achillis; if an incision of at least four inches long, the centre corresponding to that of the upper third of the leg, be made on this line, it will enable the operator to penetrate the gastrocnemius and solæus muscles, parallel, or nearly so, to the direction of their fibres; the deep aponeurosis of the leg will be then discovered, and is easily recognised by its white colour; on being divided, the

artery will be found upon the tibialis posticus muscle, accompanied by veins, and the tibial nerve, which in this situation, so high in the leg, will be often observed internal to it, or crossing it, to arrive at the external side.

The leg being now flexed, and the lips of the wound separated, will admit the application of the ligature with comparative facility in so deep a wound.

The student, when practising this operation, will be attentive not to wound the plantaris tendon, which is placed between the gastrocnemius and solæus muscles ; he will find it more feasible than the preceding operation, as it will permit him, to dissect down on the vessel in a more perpendicular manner.

Observation. If this operation be transferred to the living, no serious, if any permanent injury can be inflicted on the muscles of the calf of the leg, since their fibres are merely separated from each other, which, in case of recovery, will not interfere with their action.

The Peroneal or Fibular Artery, a little above the external Ankle. The leg being placed in the extended position, the incision should begin near the edge of the tendo Achillis, opposite to the external ankle, and be carried obliquely upwards and outwards to the fibula, for four or five inches, penetrating the skin and superficial fascia, then the finger is to be insinuated under the tendo Achillis, in order to separate it from the deep

fascia, which membrane is to be divided to the same extent as the skin ; the flexor proprius pollicis pedis is now exposed, and *the internal edge* is to be drawn outwards, when the vessel will be found at a great depth, lying partly on the interosseous ligament, and partly on the bone, the ligature is next to be carried under it and tied.

The adoption of the following operation will be found more efficacious for the peroneal artery than the preceding one. After the external incisions have been made as already described, and the flexor proprius pol. pedis exposed, in place of turning it outwards, if it be detached from the fibula for a couple of inches, the surgeon will be permitted to dissect down perpendicularly on the vessel.*

Relative Anatomy. In this situation the artery lies very deep, and is covered by the flexor prop. pol. pedis, m. ; it rests in a kind of groove situated between the interosseous ligament and the fibula : when the external incision is being made, the lesser saphena vein and the peroneo-cutaneous, or the nervus cutaneus longus posterior tibiæ are liable to be wounded, if it be carried too close to the tendo Achillis.

The Popliteal Artery, towards the inferior part of the Ham. This vessel can be secured either as it emerges from, or enters the ham ; as a prelimi-

* This vessel has been secured about four inches below the head of the fibula in a case of gunshot wound by Mr. Guthrie ; the incision was seven inches long, and passed through the muscles of the calf. *Vide Med. Chirurg. Transactions, vol. vii. p. 344.*

nary step for taking it up towards the termination of its course, the leg is to be extended and the patient laid upon the abdomen; the operation, may then be commenced by an incision, that will extend from the centre of the popliteal space downwards, and with a slight tendency outwards for four inches: the integuments and fascia being divided, a little dissection will soon expose the sciatic nerve, which is to be drawn to the inner edge of the wound, and confided to an assistant: the popliteal vein will next be seen, and subjacent to it the artery, in such intimate union with the vein, that the surgeon cannot be too attentive, when the ligature is being conveyed under it, not to wound the latter vessel; this step is facilitated by flexing the leg upon the thigh.

By the extension of this incision downwards, the student will be capable of penetrating between the heads of the gastrocnemii muscles, and secure either the posterior tibial, or fibular arteries, a short distance below their origin.

The only danger that will be incurred, is the wounding of the large muscular branches which pass from the popliteal artery to the gastrocnemii muscles, and the lesser saphena vein where it dips into the saphena magna. The communicans tibiei nerve may be also divided, in the deep incisions that are necessary to expose the artery.

The Popliteal Artery, as it enters the Ham.
The patient being situated as in the last operation, the cutaneous incision will run obliquely

downwards and outwards, from the top of the popliteal space till it arrives a little below the centre of that region, after it has penetrated the skin and fascia; if the sciatic nerve is met with it is to be drawn outwards, when the vein and artery, will be found situated in a considerable quantity of fat at the bottom of the wound; the latter vessel, rests upon the ligamentum posticum of the joint, and is covered in the most intimate manner by the vein, the artery being separated from it for a small space, and the leg flexed upon the thigh, the operator will be able to pass the needle under it without any injury to the vein.

Relative Anatomy. The form of the popliteal space may be compared to that of a lozenge, and is defined superiorly by the hamstring muscles, while the origins of the gastrocnemii m. bound it inferiorly; it contains the sciatic and peroneal nerves, the plantaris and popliteal muscles, the vein and artery of the same name, with the origins of all the articular arteries of the knee joint, also a considerable quantity of fat, which is supported by a tolerably strong fascia, that extends from one side of this space to the other. The dissection of this region, presents the following order in the relation of the parts contained in it: on the superficial plane, are the fibular and sciatic nerves at a short distance from each other; subjacent to the last nerve is the popliteal vein which covers the artery, and is so adherent to it, that too much caution cannot be used to avoid injuring the vein when the ligature is passing between the two vessels. The vein in this situation presents very much the appearance of an

artery, in consequence of the great thickness of its parietes.

The following irregularities in the distribution of this vessel, I think necessary to mention, as they may lead to some practical utility: the first I found in a boy, in whom the anterior tibial artery was given off at the superior edge of the popliteus muscle, and descended between it and the joint to penetrate the interosseous ligament at the usual place. The other, was presented to my dissections, in the leg of an adult female, in which the artery divided above the superior edge of the popliteus muscle, into two branches of equal size, which descended parallel to each other, to the inferior edge of it; the internal one gave off the posterior tibial and peroneal vessels, while the external, was continued into the anterior tibial artery. From the latter, when it arrived at the inferior edge of the popliteus muscle, a short, large trunk passed transversely inwards, and connected the two branches of the original popliteal artery. Such distributions are analogous to those we so often encounter in the forearm, and when met in practice, demand similar treatment; namely, if possible to ascertain which vessel communicates with the disease, and to secure it; if no positive evidence can be derived from such an examination, then both should be tied.

Femoral Artery, in the inferior third of the Thigh, or Mr. Hunter's operation. The patient being laid on a table of a convenient height, covered by a mattress, or a folded blanket, with the thigh semi-flexed on the pelvis, and slightly rotated outwards, will by this position define, in all probability, the course of the sartorius muscle,

which will then serve as a guide to the operator; should it not be very apparent, he must have recourse to artificial means, and draw a line from the anterior superior spine of the ilium to the centre of the popliteal space; on it the cutaneous incision is to be made, of four inches at least, in extent, corresponding to the inferior third of the limb; the integuments being divided, the saphena vein will, in all probability, be found to run in the very line of the incision; it being protected, the superficial and fascia lata are next to be cut through, to the same extent, as the skin, the sartorius muscle will be then perceived, and is to be drawn to the internal side of the wound; to allow the surgeon to divide a thin fascia that is subjacent to it, derived from the fascia lata, by which the vastus int. muscle is covered, it will then be necessary for him to cut through the dense fascia, that passes from the vastus to the triceps magnus muscle, upon a director, when the sheath of the vessels will be exposed; it being opened, and the artery separated from the vein and the saphenus nerve, the ligature is to be passed round it from within outwards; a little patience, will always favour this important step of the operation.

Relative Anatomy. In this part of its course, the artery runs in a channel formed internally by the adductor magnus, externally by the vastus internus muscles, and

anteriorly, by a strong, dense fascia, that stretches from one muscle to the other ; in it, are also contained the femoral vein, and saphenus nerve, the former placed external and posterior, whilst the latter is also on the external side of the artery, and a little anterior to it. The nerve penetrates the fascia to arrive at the internal part of the knee, and is accompanied by the ramus anastomoticus artery ; both the student, and surgeon, ought to be well acquainted with the course and relations of this vessel, or they will run considerable risk in confounding it with the femoral itself, if this operation is performed on the living.

Observation. To secure the artery in this part of the thigh, is by no means an operation easily performed, and the opinions of surgeons, as to the best mode of finding it, vary very much, as some, prefer cutting on the external edge of the sartorius muscle, while others, on the contrary, advocate the propriety of the division of the soft parts along the internal edge.

In favour of the first proceeding, the vessel is more superficial, and consequently will be sooner found, but it is conceived from the manner in which the wound is situated, if extensive suppuration ensues, there will be no outlet for the matter, which will remain lodged in the bottom of the cavity. If the operation by the internal edge of the muscle be adopted, the saphena vein is very liable to be wounded in the superficial incisions ; however, it can always be discovered by applying compression above them, which will cause it, to indicate its course by becoming turgid ; the surgeon must also recollect, that he is to penetrate between the sartorius and gracilis muscles, and should pass *directly* outwards to the

bone; this step requires greater attention than most are aware of, and if not kept in mind, the most trifling deviation from it, will lead him so astray as to render it impossible to find the vessel; this operation possesses one advantage over the first, namely, that there is a ready exit to any matter that may form.

I mentioned the probability of the ramus anastomoticus being taken for the femoral artery; it is not possible for such a mistake to occur on the dead subject, being so very small and superficial, but it has happened in the living; nay, a bundle of cellular membrane has been tied under the impression of its being the artery.* In the last edition of Sabatier's Medicine Operatoire, it is recommended to divide the sartorius should any annoyance be experienced from it during the operation. This operation, though the one selected by Mr. Hunter, is now only performed in cases where it is necessary to take up the vessel, in consequence of being wounded in this situation, and has yielded to that recommended by M. Scarpa, which is always to be adopted, when aneurism of the popliteal, or of the femoral artery, in the middle of its course is the cause which requires a ligature on the vessel.

Femoral Artery, in the upper third of the Thigh, or Scarpa's operation. The patient should recline upon a table of a moderate height, with the body supported by pillows, and the affected limb slightly bent on the pelvis, and rotated outwards, which position will cause the artery to become more superficial; the operator being situ-

* Velpeau Anat. Chirurg. vol. ii. p. 485.

ated on the outside of the limb, will commence the incision, about one inch below Poupart's ligament, corresponding to its centre, and carry it down along the thigh for four inches at least, in a direction that approaches a little nearer to the internal, than to the external part of the limb ; this incision will be found to run parallel to the artery, after the division of the skin and superficial fascia ; the fascia lata being exposed, (which in this place is very thin,) is to be cut through, when the sartorius muscle will be brought into view, and is always recognised by the length of its fibres ; if necessary, it is to be drawn outwards, the finger being then introduced into the bottom of the wound, will recognise either the artery by its pulsation, or certainly, the sheath of the vessels, which will require to be opened with every possible care, so as not to injure the contained parts, for about an inch in extent, when the artery can be separated from the vein by a blunt probe, or the nail of the finger ; the vein is generally concealed by the artery, but if large and much distended, a small part will be visible on the internal side.

The needle is then to be conveyed under the artery from within outwards, the limb being flexed, more than it was, during the first part of the operation, which, by increasing the facility of this step, will be an additional security for the femoral vein, and a small branch from the saphenus nerve.

Relative Anatomy. For the upper third of the thigh, the femoral artery is very superficial, and is merely covered by the common integuments, superficial and fascia lata; it is situated in a triangular space, formed externally by the sartorius, internally by the gracilis and adductor longus muscles, whilst Poupart's ligament constitutes the base. In this situation the great saphena vein is imbedded in the superficial fascia, and nearly indicates the situation of the artery, but is a little internal to it; we often perceive one or more lymphatic glands, of an oblong form, which are placed upon the course of the artery, and may be productive of some annoyance to the operator; if large, it will be preferable to dissect them away, than to be teased by their occasionally being in the line of the incisions. The vessel has, external to it, and on a plane inferior, the crural nerve, while on the same side, but in the sheath, is a branch of the saphenus nerve, which the student will do well to remark is always approaching the vessel as they descend the limb together; to the internal side of the artery, will be found the crural vein, which he will perceive is becoming posterior, and to the external side of it, towards the lower part of the thigh.

For the middle third of its course, the femoral artery is covered, in addition to the parts already mentioned, by the sartorius, which crosses to the internal side of it; whilst in the inferior third it receives an additional covering, derived from a tense and firm fascia, extending from the tendon of the adductor magnus, to the vastus internus muscles.

The artery, in its descent along the limb, passes anterior to the lesser trochanter, being separated from it by a

considerable distance, also over the pectinalis m., a small portion of the adductor brevis, and may be in partial contact with it; it then rests upon the adductor longus, and ultimately penetrates the tendon of the great adductor to be continued into the popliteal vessel.

When the course of the femoral artery, and its anatomical relations, are contrasted in the superior and inferior part of the limb, it scarcely needs a comment, to say which is the most eligible position for securing it; in the former, the vessel may be considered perfectly sub-cutaneous, and not bound down by any fascia; while in the latter, it receives a covering from the sartorius muscle, and is situated at a considerable depth from the surface; besides, it enters into a narrow canal, the anterior parietes of which is formed, by a firm, unyielding fascia, that renders this space very contracted; also the muscles which assist to form it are so much on the stretch during the operation, as to cause the deep part of the wound to be of a mere linear form, and oppose a considerable impediment to the needle that contains the ligature.

Observations. Many rules are given to find the course of the femoral vessel in Scarpa's triangle. 1st, Let an equilateral triangle be formed upon Poupart's ligament, the apex of which rests upon the thigh, it will indicate the position of the artery. 2nd, The point of decussation between two lines, one of which, will pass from the symphysis pubis, to the external condyle of the femur, and the other from the ant. superior spinous process of the ilium, to the internal condyle, will mark out the vessel. 3rd. If a line be drawn from the ant. superior process of the ilium, to the symphysis pubis, and made horizontal, by

depressing the external end; when bisected, the vessel will be found immediately under this point.

In the living subject, when no disease or mal-position of the thigh exist, the artery will point out its own course, as the pulsations, are in most cases visible under the integuments, thus rendering the above rules useless. Prior to commencing the operation, it is desirable to ascertain the situation of the inner edge of the sartorius muscle, which answers two useful purposes, *1st*, as a guide to the vessel; *2nd*, by cutting on the internal fibres of it, the saphena vein will be always avoided; it is advisable not to go too low in the triangular space, where the vessel is situated; for the farther it is taken up from Poupart's ligament, the more intimate its connexions with the saphenus nerve will be found to be; three and a half, or at most four inches below the Fallopian ligament, are sufficiently low to take up the vessel. This distance always insures to us, that, the profunda femoris is given off sufficiently high above the ligature, and, consequently, the circulation through it will not interfere with the processes necessary to obliterate the artery where it has been tied.

There are some varieties, in the manner in which the profunda, arises from the femoral, which I am anxious to mention, in order to lay before the reader every point of interest connected with the operation on this vessel. It generally separates from the main trunk, about one or two inches below the crural arch, and comes from its posterior, and a little from its external side: sometimes it is given off immediately under the crural arch, or even above it, and runs parallel, but external, to the femoral

vessel.* I have witnessed this origin myself: if such a variety occurred in the living subject, and that the femoral artery required to be tied for aneurism, immediately below the ligament, the operator should consider the internal one as the vessel for which he is in search. I have also witnessed the artery arising at intermediate distances between two inches, and a quarter of an inch, below the arch, and always observed the vessel to run towards the posterior and external side of the femoral artery.

This demands particular attention, as both vessels, in this place, are of the same size, consequently may be easily confounded with each other. I feel almost confident that the operator, in such cases, can scarcely be astray, if he considers the most internal, as the femoral artery; still, to avoid the possibility of an error, he should, by alternate compression, ascertain which of the vessels maintains the disease.

This operation, when performed on a healthy limb, is one of the simplest in surgery; with the single exception of passing the ligature round the vessel, so as not to wound the femoral vein, which is due to the very close adhesion between it and the artery. I am confident, if the operator will flex the thigh on the pelvis, and insinuate, cautiously, and slowly, the needle from *within outwards* between the vessels, that he will always avoid this most unfortunate occurrence.

When this accident occurs, I believe there is scarce an instance on record of the patient's recovery; from

seeing it happen in the most skilful hands, I am at a loss to account for it, but feel inclined, to impute too much confidence to the surgeon, which induces him to neglect the caution which this step demands ; and again I caution the student, when operating on the living subject, to bear in mind, the close connexion between these vessels, that he may be able to guard against such a fatality.

I am aware of but three irregularities, in the distribution of this vessel, that can in any way affect the success of this operation ; one occurred in a patient of Mr. C. Bell's,* labouring under popliteal aneurism, who died some days after the artery was tied, to relieve the affection. The *post mortem* examination, exhibited the profunda femoris coming off at the usual place, after which, the femoral divided into two equally sized branches, which descended along the thigh, parallel to each other, until they pierced the tendon of the triceps adductor magnus, after which, they united to form the popliteal. The operation was performed at the upper third of the limb, and the pulsation ceased when the vessel was enclosed in the ligature, but returned before the patient was removed from the table ; he sunk in six days after the operation. In addition to the irregularity already mentioned, the contents of the sac were found coagulated, establishing this important fact, by depriving the aneurism of half its supply of blood, it was sufficient to allow the process of coagulation to take place.

The second irregularity, and similar to the preceding, was found by Mr. Houston, one of the demonstrators to the College of Surgeons, in this city, in a young subject,

* *Lancet*, vol. x. 1825-6, p. 629.

which was brought into the dissecting room of the College; it is now in the Museum ; and in M. Portal's *Anatomie Med.* in the third volume, p. 326, we find an irregularity described very analogous to the others, “ car on a vu l'artère crurale se diviser en deux grosses branches peu après sa sortie du bas-ventre, et alors il y avoit deux artères poplitées tandis qu'on a vu dans d'autres sujets l'artère poplitée se prolonge très bas sur la jambe, avant de fournir les tibiales.”

On perusing the case in the publication (*Lancet*) referred to, it will be perceived, that pressure applied on the artery immediately below Poupart's ligament, completely arrested the pulsation in the ham ; but when the artery was compressed lower down, the pulsation was evident : if such an irregularity had been known to have previously occurred, it would have induced the surgeon, to apply his ligature upon that part of the artery which informed him where pressure commanded the flow of blood into the sac, and would have also shewn to him that the continuance of the pulsation, when the vessel was compressed lower down, depended on some variety which would have interdicted the operation in the usual place.

It has been already remarked, that, in the generality of cases, this operation, in the healthy thigh, is of easy performance, but it is by no means so, when the limb is very fat, if much œdema is present, or if the inguinal glands be enlarged and indurated, or the member is in an unnatural position : here it offers one of the greatest difficulty, which can be best surmounted by making suitably long and free incisions.

External iliac Artery. This vessel is taken up either for inguinal aneurism, or for femoral,

when it occupies the superior part of that artery ; we are indebted to Mr. Abernethy for first attempting this operation, and though unsuccessful, it fully established the fact, that the inferior extremity could be nourished, after the principal artery going to it was obliterated. Since he first operated in 1796, numerous cases, all through the civilized world, have proved the advantage derived from this proceeding ; and as Dr. Wilmot, one of the highly practical Professors of Surgery in the College of Surgeons, observes, "the recoveries after this operation have been more frequent in proportion to the numbers operated upon, than after tying the femoral for popliteal aneurism."*

Surgeons have adopted different plans for the purpose of placing a ligature about the external iliac artery ; we shall first describe the two most in use, namely, those of Mr. Abernethy, and Sir A. Cooper ; and under the head of observations, suggest an alteration in the line of the incisions as practised by Mr. Abernethy, founded on the anatomy of the parts interested in it, and from repeated trials upon the dead subject ; also we shall offer some directions which will indicate the course of the external and internal iliac arteries, of their common or parent trunk, and of the aorta, for surgical operations.

* *Vide Dublin Hospital Reports, vol. ii. p. 214,* for Dr. Wilmot's case.

MR. ABERNETHY'S OPERATION.

The patient being placed, in a reclining position, on a table of convenient height, and the hair shaved off the lower part of the abdomen and pubes, Mr. Abernethy performed this operation in the following manner:—an incision of three inches in length was made through the integuments of the abdomen, beginning a little above Poupart's ligament, and being continued upwards, it was more than half an inch on the outside of the upper part of the abdominal ring, to avoid the epigastric artery. The aponeurosis of the external oblique muscle being thus exposed, was next divided in the direction of the external wound. The lower part of the internal oblique muscle was thus uncovered, and the finger being introduced below the inferior margin of it, and the transversalis muscle, they were divided with the crooked bistoury, for about one inch and a half. He then introduced his finger beneath the bag of the peritoneum, and carried it upwards by the side of the psoas muscle, so as to touch the artery, about an inch above Poupart's ligament, and took care to disturb the peritoneum as little as possible, detaching it to no greater extent than would serve to admit the two fingers to touch the vessel. The pulsations of the artery made it clearly distinguishable from the contiguous parts, *but he could not get his finger round it, with the facility which he expected.*

This was the only circumstance that caused any delay in the performance of the operation ; after ineffectual trials to pass the finger beneath the artery, *he was obliged to make a slight incision on either side of it*, in the same manner as is necessary when it is taken up in the thigh, where the fascia, which binds it down in its situation, is strong. After this no difficulty was found in passing the fore finger beneath the artery, which was drawn gently down so as to see it behind the bag of the peritoneum. By means of an eyed probe two ligatures were conveyed round the vessel, and the artery was divided in the space between them.*

THE SECOND PLAN, OR THAT AS PERFORMED BY
SIR ASTLEY COOPER.

An incision is to be made in the direction of the fibres of the aponeurosis of the external oblique muscle, through the integuments, one extremity of which will be situated near the anterior superior spine of the ilium, and the other a little above the inner margin of the abdominal ring, by which the aponeurosis of the external oblique muscle will be exposed; this is to be divided for the entire extent, and in the direction of the external wound; and the flap which is thus formed being raised, the spermatic cord will be

* *Vide* Abernethy's Surgical Works, vol. i. p. 276.

seen passing under the margin of the internal oblique and transversalis muscles.

The opening in the fascia that lines the transversalis muscle, through which the spermatic cord passes, is situated in the mid space between the ant. supr. spinous process of the ilium, and the symphysis pubis. The epigastric artery runs precisely along the inner margin of this opening, beneath which the external iliac artery will be found. If the finger is passed under the spermatic cord, through this opening in the fascia which lines the transversalis muscle, it will come into immediate contact with the artery, which lies on the outside of the iliac vein. The artery and vein are connected together by dense cellular membrane, which must be separated to enable the operator to pass a ligature.*

COMPARATIVE MERITS OF MR. ABERNETHY'S AND SIR A. COOPER'S OPERATIONS.

That of the former gentleman will allow the vessel to be taken up in any part of its course, even as high as the origin, from the common iliac trunk, should the size and situation of the tumour require it; but in consequence of the abdominal parietes being considerably weakened by the too free incisions of the muscles, a great tendency to hernial protrusion will always re-

* *Vide Hodgson on Diseases of the Arteries and Veins*, p. 421.

main, which is the great disadvantage of the operation, and considered by some, the only one.

The operation of the latter gentleman, will permit the vessel to be secured but at a very short distance above Poupart's ligament; and should the epigastric, and circumflexa ilei arteries, rise higher than usual, the ligature may chance to be applied immediately below them; the operator being also brought immediately into contact with them, they incur a proportionate degree of danger from his scalpel; the epigastric artery was wounded in one instance, in which this method was adopted, by M. Duputryen, of the Hotel Dieu; the spermatic cord is likewise more implicated in this than in the first operation; though labouring under these disadvantages, it still possesses the great merit of exposing the artery, without any disturbance of the peritoneum.

It appears to me, that Mr. Abernethy's operation should be preferred when the patient is fat, and with a prominent abdomen, as it will alone permit us to make the incisions of sufficient length to expose the vessel; while Sir A. Cooper's will be the most judicious to adopt, if the ligature on the artery immediately above the crural arch, will be considered sufficient to remove the disease.

Relative Anatomy. The external iliac artery, after its origin, runs along the brim of the pelvis, towards the centre of Poupart's ligament, having, parallel and internal

to it, (for the two superior thirds of its course, and on a plane inferior to it,) the iliac vein: it lies on the fascia iliaca, where it passes over the superior opening of the pelvis, to be continued with the fascia of that cavity; the anterior crural nerve is described as running external to the vessel; this is certainly correct, but it is so circumstanced, namely, covered by the fascia iliaca, and placed between the psoas magnus, and iliacus internus muscles, that it can never interfere with the operation; but there is a little nerve named the genito-crural, sent from the lumbar plexus, which frequently passes to its destination upon the anterior surface of the artery, and sometimes lies external to it; the course of this nerve must be borne in mind, for reasons to be immediately explained. When the artery arrives in the vicinity of the crural arch, it is bound down by the fascia propria; this should also be remembered, since it often forms a considerable impediment to expose the vessel properly, and include it in a ligature.

Internal Iliac Artery. Glutæal aneurism, or of any of the large trunks derived from the internal iliac vessel, may require it to be secured, which can be effected in the following manner; the subject being similarly placed as in the last operation, the position of the internal abdominal ring being ascertained, or midway between the anterior sup. spin. process of the ilium and symphysis pubis, the incision is to extend obliquely upwards and outwards from that point, passing about half an inch internal to the spin. process, for at least four inches; after the integuments

have been divided, and the external and internal abdominal muscles, the transversalis abdominis will next require to be cut through to the same extent, either upon the finger or a director, that the thin transversalis fascia which lines it, may be protected; it will be also necessary, to penetrate this membrane with still more caution than the last muscle, as the peritoneum lies beneath it, which being brought into view, the surgeon will raise gently from the subjacent parts, and may rest assured that the ureter accompanies it; according as the serous membrane is elevated, he will pass his fingers, inwards towards the abdominal outlet of the pelvis, along which, the external iliac will be perceived to run; by following this vessel upwards to the sacro iliac symphysis, it will conduct him to the termination of the common iliac artery, from which the internal iliac will be found to dive into the pelvis; as both the external and internal iliac veins are in close contact with the artery, the subject of the operation, and lie partly posterior and external to it, much attention will be demanded to unravel, with the nail of the finger, their connexions from each other, so as to pass the ligature with safety to them.

This artery was first tied by Dr. Steevens;* the patient recovered; it has since been secured

* Med. Chirurg. Trans. vol. v. p. 422.

in three instances; once in the York Hospital,* in which it failed; also by a Russian surgeon, with success; and with a similar result by Mr. White, of Hudson, U. S. America; who achieved the operation by means of an incision, that extended in a semicircular course, from within two inches of the left of the umbilicus, nearly to the external ring, being seven inches long: the subsequent steps were similar to those already described.†

Relative Anatomy. The artery, after being derived from the primitive iliac, descends into the pelvis, running, in general, parallel to the sacroiliac symphysis, accompanied by a cluster of veins, which assist in forming the internal iliac; a patient search with the finger will always sufficiently disengage one from the other. The ureter descends into the pelvis, to arrive at the bladder, in almost every case anterior to the internal iliac artery, for nearly one-fourth of its course; it will be always found more adherent to the internal surface of the peritoneum than the vessel, which is proved by tearing off this membrane from the artery, even in the rudest manner, when the ureter will be seen invariably attached to it; this fact precludes any possibility of that duct being included in the same ligature with the vessel.

The internal Pudic and Glutæal Arteries. No surgeon would now think of securing either of

* Med. Phys. Jour. vol. xxxviii. p. 257.

† Johnson's Med. Chirurg. Journal, for May 1828, p. 232.

these vessels for aneurismatic affections; but if such an affection existed, he would immediately perform the operation, and tie the internal iliac artery, as advised for that vessel. It may be necessary to search for them in case of being wounded, when they run on the external surface of the pelvis; in such cases, the injury will be the best guide to the artery, and the line of incision ought always to allow the wound of the integuments to be in the centre of it.

The primitive or common Iliac Artery. The subject being placed upon a table of convenient height, and inclined in a slight degree on the sound side, the operation may be commenced by an incision, that will extend with a gentle sweep from a little below the internal abdominal ring, obliquely upwards, and about one inch internal to the anterior superior spinous process of the ilium, for at least six inches; the integuments being divided, the three abdominal muscles will require to be cut through, for the same extent, each separately; and every care taken to protect the fascia transversalis, when the third or transversalis abdominis muscle is being laid open, by having previously introduced the finger or a director beneath it. The fascia will next demand the surgeon's attention, which he will divide in the same guarded manner, as indicated in the foregoing operations. The peritoneum now presents itself, perhaps partly protruding into the wound,

which being dilated by means of retractors, the surgeon will then proceed to raise the peritoneum from the subjacent iliac muscle, slowly and gently, and with it, the ureter, and according as this is effected, he will insinuate his fingers inwards, towards the superior strait of the pelvis, where the external iliac artery will be discovered, and by tracing it upwards, will be conducted to the parent trunk, or the common iliac.

Between it, and the vein, the operator will introduce the nail of the finger, and cautiously free their adhesion to each other, in order that the ligature may be passed from within outwards, for each vessel: the reason for this rule is explained in the paragraph on the relative anatomy, which follows.

This vessel has been successfully secured in America; it has also been tied in Europe, but not with the same happy result: still the principle of the operation has been corroborated by it. See the observations.

Relative Anatomy. The common iliac artery extends from the body of the fourth lumbar vertebra, or from the intervertebral cartilage between it and the fifth, to the sacro-iliac symphysis, pursuing a course downwards and outwards; posteriorly and externally, it rests upon the psoas magnus muscle; anteriorly, it is covered by the peritoneum, which, generally, is but loosely attached to it, still, in the living subject, the adhesion may be intimate, from previous inflammation. Besides the peritoneum, we observe the left iliac is overlaid by the

sigmoid flexure of the colon, and is pressed upon by the volume of the small intestines, while the right, has the ileum resting upon it, and sometimes the caput coli. The ureters pass anterior to both vessels, just at their bifurcation, and are always more attached to the peritoneum than the vessels, invariably accompanying the serous membrane, when detached from them.

The student will pay attention to the relative position on each side, between the common iliac arteries, and their respective veins; for example, the left is the longest, and runs parallel, internal, and a little inferior to the artery; hence he will find it, I think, to his advantage, as being more safe and convenient, to pass the aneurismal needle under it, from within outwards, while the right iliac vein lies beneath, and a little external to the artery, which crosses anterior to the commencement of the vena cava inferior; this will induce him to convey the needle also from within outwards, and will allow the eye of the instrument to be immediately perceived, after it has passed between the two vessels, so as to seize upon the ligature.

From comparative trials on these vessels, I found it less difficult to include the right iliac in the ligature than the left; and equally expeditious, whether it was first passed from the internal or external side of the vessel.

Observations. In the foregoing operations, those plans are described, which have been most frequently performed, and found to answer the intentions of the operator in the most complete manner. Some surgeons, however, have deviated from them in a slight degree, and have secured the vessel, by making the external in-

cisions which control the succeeding ones, parallel to the linea alba, and external to the epigastric artery, as was done by Mr. Tait.*

It has been also advocated, to secure the internal iliac artery, by an incision upon a line that will extend from the centre of Poupart's ligament, to the umbilicus, (Harrison,) and complete the operation as has been already detailed. It is true that the vessel can be readily found by adopting such lines for the incisions; however, I have taken no small trouble to contrast these different plans of proceeding, and feel myself compelled to recommend those of Sir A. Cooper and Mr. Abernethy; deviating, however, in a slight degree from the latter; for, in place of the external incision being made in the manner he advises, it will be found more desirable, to commence it about half an inch internal, and a little higher than the ant. sup. spin. process of the ilium, and carry it very obliquely downwards, to about the middle of Poupart's ligament, or a little lower; the superincumbent layers of muscles being divided, and the transversalis fascia laid open, the operator can then easily glide beneath the peritoneum, and the subjacent parts, with very little disturbance to it, and find the artery: while the plans devised by other operators, will be found to interfere too much with that membrane; in fact they expose it both anteriorly and posteriorly.

It affords me pleasure to be able to add the testi-

* A very interesting and successful case of femoral aneurism in each limb, treated by the ligature on the external iliacs, will be found in the Edinburgh Med. Surg. Journal, vol. xxvi. p. 92, by this gentleman.

mony of M. Roux, in support of the innovation now recommended. Consult his Nouveaux Elemens de Med. Operat. tom. ii.

It will be an object of the greatest value to the surgeon, when about to engage in the highly interesting operations on the vessels under consideration, to be in possession of such bearings, between them, and the parts in their vicinity, as will, to a certainty, indicate their course.

Our data ought to be taken from the aorta, which divides into the two common iliacs, and the middle sacral arteries, on the body of the fourth lumbar vertebra, or upon the fibro-cartilage, between it and the fifth, a little to the left of the mesial line. In the adult, this point may be referred, anteriorly, to a little below the umbilicus, from one, to three quarters of an inch ; if a line be extended from it, to the centre of Poupart's ligament, it will define, for all useful purposes, the course of the common iliac, also of the external iliac : if this line be divided into three equal parts, the junction of the superior third, with the middle, will correspond to the bifurcation of the primitive iliac, into the internal and external vessels of that name. By attention to this index, the operator will be able to find the external iliac artery, which, by pulsation, and the firmness of its tissue, will conduct him, both to the internal, and common iliac arteries, if he deems it not prudent to seek for them in a direct manner ; it will also mark for him, the precise part of the latter vessel, upon which he is to apply the ligature, so as to be certain that a considerable portion of the vessel intervenes, between it, and the origin from the aorta ; if the attempt is to be ventured on the aorta it-

self, he will be capable of including it in a ligature, at that part of its course, which will be, at the least, one inch below a vessel of any magnitude, and will, consequently, guarantee the formation of the internal coagulum.

In another respect, besides the application of a ligature, upon any of these vessels, advantage is derived from a knowledge of their course, indicated by these directions, as it will procure for us a guide to command the flow of blood, in the external iliac artery; for instance, by directing compression obliquely, downwards and outwards, upon the line that shows its course; if the patient be thin, the vessel will be compressed against the superior strait of the pelvis; this can be resorted to, as an accessory means, to obviate haemorrhage, in amputation in the hip joint.

When these operations are undertaken upon the living, the necessity of clearing out the large intestines, by enemata, a short time previous to the operation, is self-evident; when engaged in the operation, the surgeon cannot be too prudent, as he approaches the transversalis fascia, which is sometimes dense and firm, at others, the reverse, to divide it, so as not to injure the peritoneum, which is not unfrequently observed, to be extremely thin and delicate, and may be lacerated in the easiest manner, though the usual attention has been bestowed, to separate these membranes from each other. If such an accident takes place, very alarming, if not fatal symptoms ensue. However, in Dr. Post's operation, on the external iliac artery, the peritoneum was so thickened, and adherent to the artery, that it could not be separated from it; he was compelled to cut it, and

even enclose a part of it in the ligature: the patient recovered. Unavoidable injury was inflicted on the abdominal serous membrane, in one of Mr. Tait's operations, when the patient barely escaped death.

If the reader refers to the operation on the external iliac, as performed by Mr. Abernethy, he will see that I have marked in *italics*, the difficulty which he experienced, in consequence of omitting, in the first instance, to divide the fascia propria, which is of much importance, for the easy and expeditious performance of the operation.

After the peritoneum is detached from the anterior surface of the vessel, if the genito-crural nerve, is at all in the way, it must be sacrificed, sooner than delay the operation, by trying to save it; since its division can be productive of no possible injury.

The fascia propria, which may be considered partly as a condensation of the subserous cellular membrane, will require to be opened, by pinching it up with the forceps, and cutting it longitudinally, to allow the application of the ligature. I would recommend the student, when dissecting this vessel, to mark well the situation of one or two large, oblong, lymphatic glands, which lie parallel to, and on the artery, that he may incur no trouble from them in his subsequent operations; they are generally near the Fallopian ligament. It may not be amiss to mention a very irregular origin, of a renal artery, from the right iliac, which was given off, about the middle of its course, and ascended to supply a portion of the kidney, on that side.*

* Velpau Anat. Chirurg. tom. ii. p. 165.

It was to be expected that the surgeon, who passed a ligature round the arteria innominata, would, when an opportunity presented itself, undertake the equally hazardous one, of securing the common iliac; we accordingly find, that Dr. Mott, of Philadelphia, has added another laurel to his name, and afforded additional evidences of what benefits can be extended to the relief of human suffering, by well planned, and executed operations, by placing a ligature upon this vessel.

The case is so very interesting, both in describing the different steps of the operation, and the difficulties attendant on it, that no apology is necessary for detailing it in full.

The subject of the operation was Isaac Crane, æt. 33, a farmer, of temperate habits, but accustomed to hard labour; the tumour was scarcely of three months' existence, and extended from a little above Poupart's ligament, on the right side, nearly to the navel, and almost as far forward as the linea alba; it seemed to fill up all the concavity of the ilium.

" The patient being placed upon a table of suitable height, the pubes and groin of the right side being shaved, an incision was commenced, just above the external abdominal ring, and carried in a semicircular direction, half an inch above Poupart's ligament, until it terminated a little beyond the anterior superior spinous process of the ilium, making it in extent, about five inches. The integuments and superficial fascia were divided, which exposed the tendinous part of the external oblique muscle, upon cutting which, in the whole course of the incision, the muscular fibres of the internal oblique were exposed, the fibres of which were cautiously

raised with the forceps, and cut from the upper edge of Poupart's ligament. This exposed the spermatic cord, the cellular covering of which was now raised with the forceps, and divided to an extent sufficient to admit the forefinger, of the left hand, to pass upon the cord, into the internal abdominal ring. The finger serving now as a director, enabled me to divide the internal oblique, and transversalis muscles, to the extent of the external incision, while it protected the peritoneum. In the division of the last-mentioned muscles, outwardly, the circumflexa ilei artery was cut through, and it yielded, for a few minutes, a smart bleeding. This, with a smaller artery upon the surface of the internal oblique muscle, between the rings, and one in the integuments, were all that required ligatures.

" With the tumour beating furiously underneath, I now attempted to raise the peritoneum from it, which we found difficult and dangerous, as it was adherent to it in every direction. By degrees we separated it, with great caution, from the aneurismal tumour, which had now bulged up very much into the incision. But we soon found, that the external incision did not enable us to arrive at more than half the extent of the tumour, upwards. It was therefore extended, upwards and backwards, about half an inch, within the ilium, to the distance of three inches, making a wound in all about eight inches in length.

" The separation of the peritoneum was now continued, until the fingers arrived at the upper part of the tumour, which was found to terminate at the going off of the internal iliac artery. The common iliac was next examined, by passing the fingers upon the promontory of

the sacrum, and, to the touch, appearing to be sound, we determined to place our ligature upon it, about half way between the aneurism, and the aorta, with a view to allow the length of vessel enough on each side of it, to be united by the adhesion process.

" The great current of blood through the aorta, made it necessary to allow as much of the primitive iliac to remain between it and the ligature, as possible ; and the probable disease of the artery, higher than the aneurism, required that it should not be too low down. The depth of this wound, the size of the aneurism, and the pressure of the intestines downwards, by the efforts to bear pain, made it impossible to see the vessel we wished to tie. By the aid of curved spatulas, such as I used in my operation upon the innominata, together with a thin piece of board, about three inches wide, prepared at the time, we succeeded in keeping up the peritoneal mass, and getting a view of the arteria iliaca communis, on the side of the sacro-vertebral promontory. This required great effort on our part, and could only be continued for a few seconds. The difficulty was greatly augmented by the elevation of the aneurismal tumour, and the interruption it gave to the admission of light.

" When we elevated the pelvis, the tumour obstructed our sight ; when we depressed it, the crowding down of the intestines presented another difficulty. In this part of the operation, I was greatly assisted by Dr. Osborn, and my enterprising pupil, Adrian A. Kissam. Introducing my right hand, now, behind the peritoneum, the artery was denuded, with the nail of the forefinger, and the needle, conveying the ligature, was introduced, from within outwards, guided with the forefinger of the left

hand, in order to avoid injuring the vein. The ligature was very readily passed underneath the artery, but considerable difficulty was experienced in hooking the eye of the needle, from the great depth of the wound, and the impossibility of seeing it. The distance of the artery from the wound, was the whole length of my aneurismal needle.

" After drawing the ligature under the artery, we succeeded, by the aid of our spatulas and board, in getting a fair view of it, and were satisfied that it was fairly under the primitive iliac, a little below the bifurcation of the aorta. It was now tied; the knots were readily conveyed up to the artery by the forefingers; all pulsation in the tumour instantly ceased. The ligature upon the artery was a very little below a point opposite the umbilicus."

The wound was dressed in the usual way: the operation lasted less than an hour. It was performed on the 15th March, and the ligature was removed from the artery on the 3rd April following. On the 20th of May, he made a journey of twenty-five miles.*

" In the August of the same year, Mr. Crampton, (Surgeon-General,) of this city, secured the primitive iliac artery, on the right side; the operation was accomplished with little difficulty, and occupied but twenty minutes in the performance; the patient survived till the eleventh day, when he suddenly expired.

In this operation, which was performed with that gentleman's usual skill and dexterity, it is a matter of much regret that the common silk ligature was not used,

* Johnson's Med. Chir. Review, vol. viii. 1828, p. 472.

which would have done its office in a more determinate, and effectual manner, than one of catgut would, which was the kind substituted, to supply the place of the silk, as the following extract from the *post mortem* examination will shew:—" It was found that the vessel had been tied in such a manner, as to divide the internal coats completely through ; a small portion of lymph occupied the situation of the ligature, within the vessel, and outside of it, there was a larger quantity, together with about a spoonful of purulent matter. The vessel, however, was pervious into the aneurismal sac, and the ligature had disappeared altogether. One extremity of it had been hanging from the wound, on the seventh or eighth day, and therefore it is supposed, that the catgut, which had been very firmly tied with a double knot, had become macerated, and either gave way, and broke before the impulse of the blood, or had actually rotted."*

The Aorta. This vessel has been secured in two instances; the first, by Sir A. Cooper, the second by Mr. James, of Exeter ; both operations were unsuccessful.

Sir A. Cooper was induced to make the trial secondarily, for aneurism of the external iliac artery. It had been opened by sloughing, and the patient lost a considerable quantity of blood ; he first endeavoured to secure the vessel, that maintained the disease, in which he failed ; he then proceeded to tie the aorta, and made an in-

* *Lancet*, vol. ii. 1828, p. 570—634.

cision into the linea alba, three inches long, allowing a curve in it, to avoid the umbilicus; having penetrated into the cavity, he passed his fingers between the convolutions of the intestines, to arrive at the posterior part of it, and recognised the artery, by its strong pulsation; the peritoneum was then lacerated by the finger nail, which allowed him to convey the ligature around the vessel and tie it. It was applied about three quarters of an inch above the division of the aorta.

The patient survived the operation forty hours.* Mr. James† performed a similar operation, to that by Sir A. Cooper, in July, 1829; his patient died in a few hours after it.

If it should be considered expedient again to secure the aorta, it can, with great facility, be accomplished, by the operation recommended for the common iliac, which will allow the vessel to be tied immediately above the bifurcation, at which point the ligature will be about one inch below the origin of the inferior mesenteric artery.

Observation. Though it is a very delicate question, in a physiological point, to decide, if, after this operation, the collateral circulation will be established in sufficient time to nourish healthily, the parts below the ligature; still, from the partial success of Sir A. Cooper,

* Cooper and Traver's Surg. Essays, vol. i.

† Guthrie's Diseases of Arteries, p. 363.

the patient ought not to be abandoned, without something being attempted for his welfare ;—for, should nothing be ultimately gained, but the prolonging of life for some hours ; even this extension, short as it is, may, in some instances, be of infinite service to the friends and survivors of the patient.

Some valuable pathological facts have been published by Dr. Graham,* Meckel,† and by M. Renaud,‡ satisfactorily proving that the inferior part of the thorax, the abdomen, and inferior extremities, were freely supplied with blood, and properly nourished, after the aorta had been nearly obliterated, at the termination of its arch ; still such a state, differs materially from the consequences likely to result after a ligature has been applied as a remedial means on this vessel, the passage of the blood being thus suddenly arrested, reasoning, *a priori*, it is liable to be attended with more injurious effects to the system, than when it is checked by the formation of a stricture, which is developed imperceptibly, and allows the collateral circulating vessels, to dilate, *pari passu*, as the aorta diminishes in calibre.

My anatomical cabinet, contains a splendid specimen, in corroboration of what has been stated by these gentlemen ; it presents the following lesions :—the heart is hypertrophied, with dilatation of both ventricles, and the pericardium is universally adherent to it ; the aorta is dilated to the completion of the curvature, where it is so contracted, that a goose quill can scarcely pass through it,

* Med. Chirurg. Transactions, vol. v. p. 287.

† Meckel, Achie. für Anatomie and Physiologie, June, 1827.

‡ Journal Hebdomandaire, vol. i. p. 161.

and may be compared to the effects of a ligature, so narrow is the stricture; below it, the vessel instantly acquires its natural size: the interior of the arch is closely studded with broad steatomatous tumours. The individual from whom it was taken, prior to his last illness, was a full, muscular man; and had arrived to about his fortieth year. I am indebted to my intelligent and zealous friend, Surgeon Jameson, for this rare and interesting piece of pathology.

CHAPTER IV.

AMPUTATION OF THE SUPERIOR EXTREMITIES AND INFERIOR MAXILLA.

AMPUTATION, the last resource of the surgeon, ought never be carried into execution, till all hopes of preserving the limb, as a useful member, are lost, and the life of the individual would be compromised, by a further perseverance in those measures, which are supposed capable of arresting the disease; though the affections, that demand this severe remedy, are still too numerous, happily, for mankind, they are not so frequent, as they were some years since, which is due, to the improved state, both of our pathological, and therapeutical knowledge; which em-

powers the surgeon, to preserve many limbs, which, at that period, were consigned to the knife: this remark is particularly applicable to compound fractures, which almost invariably turn out well, unless of a very aggravated kind, and to some diseases of the joints; still it is a subject of regret, that much as our treatment of disease is advanced, there are many cases, in which the young surgeon, will find it necessary to decide on the operation. In the following chronic affections, the surgeon cannot err in proposing amputation for their relief; and can also select his own time for the performance of it, which is no inconsiderable advantage, and ought, if possible, be always in the early part of the day; by so doing, the state of anxiety that the patient labours under, will, in all probability, subside, prior to the night coming on, and consequently, favour the approach of sleep; it has also been observed, if secondary haemorrhage occurs, in consequence of the misapplication of a ligature, it generally takes place, in a few hours after the operation, so that the surgeon will have the great advantage resulting from daylight, to look for, and secure the artery. *1st*, mortification of a limb; *2nd*, extensive and deep carious affections of a joint; *3rd*, necrosis, when suppuration is very great, and the patient's health is unable to bear up against the disease; *4th*, spina ventosa, and very large exostoses; *5th*, cancerous affections, that cannot be removed, without

wounding the principal vessels and nerves of a limb, or from their situation, are so deep, as to render it impossible to bring them away, but by amputation; 6th, scrofulous affections of the joints, generally denominated white swelling; 7th, aneurism, which has caused the absorption of the bone, and produced great destruction of the soft parts; 8th, and lastly, extensive and continued suppurations, which induce hectic fever.

If, occasionally, any embarrassment is experienced by the young practitioner, to decide on the propriety of amputation, in any of the preceding affections, he will find himself more perplexed to come to a decision, in those which appear to call for it on the instant, from the severity of the accident, and the injury inflicted on the constitution, as nature often produces a restitution of health, which, to every sound and reflecting mind, appeared impossible.

Such lesions, have given rise to the question, of primary and secondary amputation; the first being effected as soon as the patient has recovered from the shock of the injury, while the second is never performed, till other means have been employed to preserve the limb; if these fail, it is then unavoidable, as the only means left to save the life of the sufferer. The necessity of adopting primary amputation, in many instances, demands great discrimination; the succeeding accidents generally indicate the propriety of it, as soon as the patient has recovered

from the shock of the injury : 1st, when a limb has been carried away by a cannon shot; 2nd, when the soft parts, including the arteries and nerves, are so contused, as to leave no hopes of recovery, unless the limb is removed ; 3rd, in cases where a great mass of the soft parts have been torn away, as the muscles from the back of the thigh, or the calf of the leg ; 4th, in fractures, accompanied with compound luxation, especially in the ginglymoid joints ; 5th, where a ginglymoid articulation has been extensively opened, with a wound of the principal arteries, and nerves ; 6th, where the principal artery of a limb has been opened, and the member so stuffed with blood, as to render it impossible, to discover the vessel and tie it ; 7th, in wounds of large joints, accompanied with the presence of foreign bodies, which cannot be extracted ; 8th, Boyer advocates this operation, in luxation, of the astragulus, without an external wound ; either with, or without a wound, this is a very questionable practice ;* 9th, some advise it, amongst whom are Sabatier and Percy, when the principal artery of a limb is opened near the trunk, under the impression, that the circulation cannot be carried on, below the wound ; this is also to be received with caution ; 10th, Larrey recom-

* I know of two cases, in which the astragulus was extirpated, and the patients recovered, with a very serviceable foot.

mends it at the first invasion of traumatic tetanus.* 11th. In *traumatic gangrene*.

For additional information, on the value of primary amputation; as it would be altogether foreign to an elementary treatise to discuss this question, I refer the reader to the works of MM. Guthrie, Hennen, Copeland Hutchinson, and Larrey, with every confidence of his being amply repaid for his trouble, and for most useful information upon this subject.

Amputation is performed, either in the continuity of the limbs, or in their articulations, the leg, the thigh, the arm, and fore-arm, present us with those portions of the frame, in which it is practised in the former; while the phalanges of the fingers and toes, metacarpal and tarsal joints, partial removal of the foot, of the hand at the wrist, also those of the shoulder and hip joints, and lately at the knee joint,† instance the latter. When it is necessary, to operate in the continuity of a member, the following instruments are required: an amputating knife and a scalpel, a tourniquet, tenaculum and forceps, a saw, bone-nippers, scissors, ligatures of various sizes, from the single to the three threaded one, adhesive plaster, and rollers, and a retractor: on the contrary, when the operation is to be per-

* The practice has not been corroborated by other surgeons, and is most questionable.

† London Medical and Physical Journal, July 1826, p. 90.

formed, in the articulations, some of the former can be dispensed with, as the saw, bone-nippers, and tourniquet.

We shall preface the particular operations, by a few remarks on the use and selection of some of the instruments employed in them; also, on the different methods recommended, for the section of the soft parts; to perform these operations with the requisite neatness and elegance, and with perfect security to his patient, the surgeon will require from two, to three assistants, whose duty is to confine the limb *in situ*, to assist in the retraction of the soft parts, to command the tourniquet, and to facilitate the securing of the vessels, so as to prevent hæmorrhage.

On the manner of applying the Tourniquet. As a general rule, it should always be placed as high as possible on the limb, so as not to prevent the retraction of the muscles, when divided; if it can be so managed, it is better to apply it above the joint, below which the operation is to be performed, as it will scarcely then interfere with their retraction. The pad or compress, on which the screw of the instrument is to be placed, should be firm and narrow, and made of a piece of hard wood, equal to the length and thickness of a well-sized thumb; it must be enveloped in a few turns of a roller, and then secured in the centre of a bandage, of a sufficient length, to surround the limb; the compress ought always be placed,

oblique to the course of the vessel, which insures its pressure more effectually, than if it was parallel to it, and the ends of the bandage, containing the compress, pinned on the outside of the limb. The strap of the tourniquet is then to be carried round the member, and the instrument situated immediately over the compress, with the screw perfectly free, when the strap is to be drawn tight and buckled on the outside, so as not to come in contact with the screw, which is to be turned, till the pressure is sufficient to arrest the circulation. If the screw, requires to be turned for more than half of its length, to effect this purpose; the strap is either too loose, or the compress is not properly situated, and all, must be again arranged: when the limb is much emaciated, it will be found of service, to make a couple of turns of a roller round it, before the tourniquet is applied, which will protect the integuments being cut by the strap, when the screw is tightened. The strap of every tourniquet, ought to have a second buckle attached to it; there should be also furnished with it, a second strap, in case one should break.

I would advise the young practitioner, in every instance, to apply the tourniquet himself; as he will often prevent much embarrassment during the operation; if he does not conceive it necessary to do it himself, let him never presume to operate until he has examined that it is properly arranged.

Attention to the preceding rules will always permit the proper application of the tourniquet; but is it to be used, on every occasion? it was formerly taught, that this was the only means to prevent hæmorrhage during amputation; an idea which ought to be received with considerable limitation, as it is now well ascertained, whenever it is an object, to perform an almost bloodless operation, it is better to dispense with that instrument, and confide the command of the circulation, to simple compression, of the main artery of the limb, which in every instance, can be effected by a cool and collected assistant, with his fingers; neither is it necessary, that he should possess much strength, nor constantly apply the pressure, as it will be merely requisite to do it, at the time, the principal vessel is being divided, of which he is as fully aware, as the operator himself; by pursuing this method, the loss of blood from venous hæmorrhage, is always prevented, as no circular compression is exercised upon the limb, by the strap of the tourniquet, which in very debilitated patients should be constantly taken into account.

The surgeon has his option of the circular, or the flap amputation; the latter may consist of one, or of two flaps; one, or other of these must be selected, for removing a limb in its continuity; whilst the flap operation is almost invariably resorted to in the different articulations.

Of late years, some surgeons wish to supersede the circular amputation, by the universal adoption of the flap, for limbs however circumstanced; this practice is too exclusive, as it is impossible, that one species of operation, can be made subservient to every case, and every limb. That surgeon, will consult his own interest, and the welfare of his patient best, who does not confine himself, to one particular kind of operation, but will adapt it to the exigencies of the case, be it the circular or the flap; by the exercise of such discretion, the amputation will be attended with the greatest benefit to the patient.

As to the celerity of performance, there is no manner of doubt, but the flap operation can be achieved in a much shorter period than the circular one.

The surgeon, when about to amputate the arm or the thigh, generally stands on the outside of the limb; for the leg, and fore-arm, on the inside: by the first position, he will be least incommoded by the patient, while, by adopting the second, he can effect the sawing of the bones better.

If the circular operation is selected, the skin ought to be rendered as tense as possible; which is effected by an assistant grasping the limb, and drawing the integuments upwards, while another stretches them in the contrary direction, this will always insure a clear incised wound, and what is

also of some moment, less pain will be caused ; the surgeon will observe, when making the first incision, to divide not only the skin, and subjacent cellular membrane, but also to cut through the fascia, unless it is particularly interdicted, which will allow him to retract these membranes, without the necessity of detaching them from the subjacent parts by dissection, which is not alone painful, but is also attended with much delay.

In Secondary Amputations, when the skin has been consolidated to the subjacent parts, by previous inflammation, it must be dissected from them, to allow of retraction : the muscles are then to be divided, at two different incisions, and the bone laid bare, in proportion to the size of the limb, to such an extent, as when sawed, it will be buried in the soft parts. Some surgeons impress the necessity of dividing the periosteum, as a separate step ; no advantage results from it, it may therefore be dispensed with ; the retractor is then to be applied, and the bone sawn in the manner below pointed out.

If the flap operation be preferred, the integuments are to be drawn upwards, either by the operator, or by an assistant, when the former will pass a catlin through the limb, till it meets the bone ; the point is then to be passed by the side of it, until it has traversed the opposite side of the member ; the knife will then cut its way cutwards, so as to form a flap with a convex edge ;

the second flap is to be made in the same manner. This is the most usual way of operating, so as to have two flaps; sometimes the reverse of this plan is adopted, or cutting from without inwards, without any previous transfixing of the limb, with a catlin; the cases in which this style is to be preferred, will be particularly mentioned.

For flap operations, the catlin which is double edged for the entire of its length, is one of the worst knives, that can be used; as the more it traverses the limb, the greater will be the longitudinal splitting of the arteries, which is one of the principal objections, brought against this operation; to remedy such an inconvenience, a catlin should be preferred, which is only double edged for a very short distance from the point, an inch or so, and the remainder of the back, bevelled off, to remove the thickness which it would otherwise have, and which may present some resistance, while the limb is being penetrated by it; such an instrument as this, will split the arteries in but one point, and as soon as the double edged part has passed through the vessel, the remaining portion of the knife, cannot commit any further injury on it. The larger knives, that are furnished with the amputating cases, as now made, are not to be objected to, unless they have concave edges, which are to be instantly rejected, for those which have straight ones; if the operator will contrast the circular

incisions made with a concave, and with a straight edged knife, he will instantly decide in favour of the latter.

For the various amputations on the hand and foot, the operator ought to be provided with strong, straight edged, and pointed scalpels, also with a chain saw.

How to use the Saw. A bone may be splintered in two ways; either by the assistant depressing it too much, when it is being sawed, or by not sufficiently supporting it; in the first, the manner in which it occurs is quite evident, whilst in the second, the saw becomes "locked," and will not work with freedom, in consequence of which, the surgeon attempts to force through the impediment, and a splintered bone is invariably the result, whereas, if he had recourse to more gentle means, when such an occurrence takes place, no splinter will be made, as the saw may be rendered free, by depressing the bone ever so little.

If much force is used, to disengage the saw, when locked, it is very liable to break; this accident occurred to Fabricius Hildanus.

Provided the following directions be attended to, when a bone is being sawed, a smooth section will be always obtained. The heel of the saw is to be first placed on the bone, and supported by the nail of the left thumb, and then drawn to the point; after which, it is to be pushed from the point, to the heel, and by a repetition of regular

and slow movements of this kind, and for the whole length of the instrument, pressing but lightly on it, no risk will ever occur of splintering the bone; but if short and quick movements, which do not engage a third of the saw's edge, be resorted to, it will be almost impossible to avoid leaving spiculæ.

Before the section of the bone is complete, the point of the saw ought to be directed downwards, till it comes nearly perpendicular to the horizon, which will then cut through the under part of the bone, and leave that next the operator, to be divided the last. By attending to these directions, it is scarcely possible to splinter the bone.

In the choice of a saw, that should be selected, which has the edge a little thicker than the blade; it also ought to be somewhat heavier than those usually made, and if it cuts both ways, it is to be preferred to a saw that cuts only in one direction.

After the limb is removed, the next step consists in securing the arteries; the largest, is the first to be tied; for which purpose, it must be drawn out from the surrounding parts, either with a tenaculum, or a forceps, and the ligature applied, sufficiently high, as not to be endangered of being forced off the vessel, by its pulsation, and tied with a double knot: sometimes, it will be difficult to find this vessel, in consequence of it retracting within the sheath; in

such a case it will be advisable to slit it open, when the vessel will be found, presenting an open mouth; the remaining arteries are to be secured in a similar manner, and one of the ends of each ligature cut off, or both, as has been already mentioned, *vide* page 7.

It sometimes happens, that the principal artery is ossified, when it will be found to give way, under the application of the ligature; in such cases, the surgeon is compelled to include a portion of the surrounding parts in the noose of the ligature, or to interpose between it, and the artery, a bit of lint, if the soft parts are so diseased, as to render them unfit to support the necessary pressure, exerted by the ligature. After all the visible bleeding vessels have been secured, and the operator is anxious to discover, if more require to be tied, he, or the assistant, who has charge of the tourniquet, too often unscrews it, in the slowest, and even most timid manner; this practice, is not altogether very judicious, as it permits the blood to flow, in the same way, through the vessels, and with a degree of force, not sufficient, to remove any coagulum, that may have formed on the cut extremity of the vessel, which has not been secured; neither is the strength of the current of blood, equal, to overcome, the temporary contraction of the vessel, which the circulation will be able to effect, after the stump has been dressed, and reaction has taken place: to obviate

such an occurrence, the tourniquet should be freely, and suddenly unscrewed, when a rush of blood will follow, that will wash away the coagulum, overcome the temporary contraction of the vessel, and by its appearance, will indicate the situation of the artery, which can be instantly secured.

The face of the stump should be then sponged, with cold water, and well dried with a soft napkin ; the ends of the ligatures are next to be so arranged, as to occupy, as small a part of the stump as possible, and a knot tied upon that which surrounds the largest artery, to distinguish it from the rest : before closing the wound, the surgeon will be careful that none of the tendons or nerves lie between the lips of it, as the latter possess very little retractile property, they probably would remain in it, and become bulbous, which often gives rise to severe neuralgic affections.

Amputations on the Hand ; Removal of the second and third Phalanges of the Fingers. First plan. The finger being extended, and the skin retracted, the surgeon will make a circular incision, about half an inch beyond the articulation, at which the removal is to take place, through all the soft parts, to the bone ; then on each side of it, he will make a longitudinal one, from the first incision, to the joint ; by this means, two flaps are formed, the one anterior or palmar, and the other posterior or dorsal, which are to be dis-

sected back, and the capsular and lateral ligaments divided, to terminate the operation.

Second plan. Having flexed all the fingers, but the one that is to be amputated, and the hand being placed in a state of pronation, the operator will make a semicircular incision, three lines beyond the joint, the convexity looking towards the nail, and divide the skin, the extensor tendons, capsular and lateral ligaments; he will then luxate the phalanx, and pass the knife between the bone and soft parts, on the palmar surface, to form the second flap, observing, that its length, in conjunction with the dorsal one, will be sufficient to cover the bone.

Third plan. The diseased finger being semi-flexed, which will cause the head of the phalanx to project; the operator will, as if it was his intention to split the head of the bone with the scalpel, divide all the soft parts on this surface of the articulation, and form the dorsal flap; the lateral ligaments are then to be cut through, when he will be able to traverse the joint, and form the palmar one.

Observation. Strictly speaking, this operation ought not to be performed, in the articulation between the first and second phalanx, as none of the long flexors, are attached to the first of these bones; from whence it will result, if the amputation is performed in the joint now alluded to, the bone will remain constantly extended, and will be always in the way of foreign bodies; consequently liable to various accidents.

To remedy this inconvenience, M. Lisfranc, has proposed making a longitudinal incision, on the first phalanx, to expose the flexor tendons, and cut them across; they will, in a little time, unite to the bone, by inflammation: when the wound is cicatrised, the finger may then be removed. It is doubtful, if the object intended will be gained, by such a proceeding; the patient submits to a double operation, and considerable risk is incurred of exciting inflammation, in the fibrous tissues, which is always of serious consequence.

Amputation of a Finger in the metacarpophalangar Articulation. Having pronated the hand, the operator will seize the finger that is diseased, and flex it, in order to ascertain the position of the joint, then commence the operation, by placing the heel of a full-sized scalpel, on the head of the metacarpal bone, and cut parallel to the digital surface of the first phalanx, so as to form a lateral flap, taking care, that the incision has the same extent on the palmar, as on the dorsal side of the finger; the flap thus made being reflected, the operator will pass the knife along the denuded part of the bone, till it meets the joint, which he will open and traverse; so as to bring the knife forward, along the phalanx, on the opposite side, and make the second flap, corresponding in size to the first.

If this operation is performed on the index, or the little finger, the external flap of the former, and the internal of the latter, ought to be the largest of the two flaps.

Observation. When it is either the middle, or ring finger, that is to be removed, many surgeons conceive it more advisable, to make the incisions posterior to the metacarpo-phalangar articulation, so as to allow the head of the metacarpal bone, to be separated from its lateral connexions ; having then divided the flexor, and extensor tendons, in the angles of the incisions, (which will be found to be on the dorsum and palm of the hand,) the metacarpal bone is sawn, posterior to its head, in an oblique direction, the soft parts on each side of it, having been previously protected, either by a retractor or a piece of card.

This method is supposed preferable, to the operation in the articulation, for the following reasons, the heads of the metacarpal bones, which articulate with the phalanges, are so large, that, if the operation is performed in the articulations of the ring and middle fingers, the remaining fingers will be separated from each other, by a considerable interval ; also some deformity will remain, and the hand will be weakened, since the fingers no longer mutually support each other. By adopting the plan of sawing off the head of the bone, the remaining fingers are approximated to each other, no deformity is present, and the strength of the hand is scarcely affected, as its component parts are supported, in the same manner that they were, prior to the operation.

If the fore and little fingers, are amputated, in this manner, the incisions ought, if possible, to be dorsal, and palmar, to allow of flaps being made, to correspond to those surfaces ; when formed, they can be reflected, so as to expose the bone, posterior to its articulating surface, which is then to be sawed. By the adoption of this

method, an unsightly appearance will be obviated, caused by the projection of the head of the metacarpal bone; the wound will also unite more rapidly, than over an articulating surface.

Amputation of the Thumb, in the carpo-metacarpal Articulation. First plan. If it is the right thumb, the hand is to be supinated; if the left, in the opposite position, and secured by an assistant; while the operator will seize the thumb, abduct it from the rest of the fingers, and apply the point of a full sized scalpel in the middle of the space, comprised between the metacarpal bones of the thumb, and index fingers, and will pass it boldly through the soft parts, at the same time abducting the thumb, as they are being divided, till it meets with the os trapezium, or falls upon the joint; he will then turn the edge of the knife outwards, and open the articulation, by dividing the internal part of the capsular ligament; which will permit him to glide through the joint, so as to arrive at the external side of it, when he will finish the operation, by cutting forwards towards himself, along the metacarpal bone, partly on the palmar, and partly on the radial surfaces of it, and form a flap of sufficient size, as will cover the surface of the wound.

Second plan. The hand being placed between pronation and supination, the surgeon will ascertain the situation of the joint, and from

its most prominent part, (which is external,) make an incision on each side of the metacarpal bone, to the base of the first phalanx, which will form an oval, containing the metacarpal bone in its area; and will continue the operation, by dividing the muscles situated in the metacarpal space, which are attached to the bone of that name, and phalanges of the thumb. The surgeon will next abduct the metacarpal bone, and cut through the ligaments, which unite it to the trapezium, and remove it. If any arteries bleed, they are to be secured, and the flaps united.

Observation. If the operation, according to the first plan, is selected, when the soft parts, between the thumb and index finger are being divided, the edge of the knife ought to be applied close to the former, or what is better, it should be inclined outwards; attention to this direction, will always enable the operator to enter the carpo-metacarpal articulation. If he is heedless of this precaution, the knife is almost sure to penetrate, between the os trapezium and trapezoides, the first of these bones will be removed, together with the thumb, and the flexor carpi rad. tendon, unnecessarily sacrificed; a reference to an articulated hand, establishes the justice of this remark; and performing the operation, on the dead subject, without attending to what has been said, will also prove its truth.

The flap formed by this operation, is often very thin and poor.

The operation, by the second method, though not so

quickly performed, still, gives two very good flaps, one internal, and one external, while the trapezium is not endangered of being removed by it, and the tendon of the flexor carpi radialis preserved.

In those operations, the surgeon will be occasionally empowered, by the nature of the disease, or accident, to allow the base of the bone to remain, which, will continue to the patient the use of the extensor ossis metacarpi pol. manūs.

Amputation of the little Finger, in the carpo-metacarpal Articulation. The surgeon has a choice of three operations, for this purpose. First plan is similar to the first, for removing the thumb, and may be performed in the following manner:—the soft parts between the fourth and fifth metacarpal bones, are to be divided, at one sweep of a scalpel, by running it from before backwards, till it is arrested by the os unciforme; when the edge is to be turned inwards, and the bone, at the same time, is being abducted from the others; by this means the joint will be opened, which is to be traversed inwards, and the internal lateral ligament cut across; after which, the knife is to be brought forwards, close to the ulnar side of the metacarpal bone, till it arrives at the metacarpo-phalangar articulation, so as to form the flap, from all the soft parts that lie on the cubital side of the metacarpal bone.

Second plan. Prior to commencing the operation, it will be necessary to ascertain the situation of the articulation between the metacar-

pal bone, and the os unciforme; which can be done, by passing the finger along the internal side of the former, till it meets with a prominence at the carpal end, and internal side of it; the joint is situated immediately behind this process.

This point having been found, the surgeon will pronate the hand, and seize the soft parts, which are on the ulnar side of the metacarpal bone, and draw them inwards, which he will traverse, a little posterior to the joint, with a scalpel, from the dorsal, to the palmar surface of the hand, and will bring it forwards, close to the bone, a little beyond the metacarpo-phalangar articulation, to form the flap; an assistant will then take charge of it, while the operator will carefully insinuate the knife, between the fourth and fifth metacarpal bones, without injuring the integuments on either surface of the hand, and separate the connexions between them, by cutting from behind forwards; by this step, he will free the bone from all its adhesions, but those at the carpal articulation, which he will open by entering it, immediately behind the tubercle, and cutting on a line that will pass, from its internal side, to the middle of the second bone of the metacarpus.

Third plan, may be accomplished, by an incision that extends from the carpal extremity of the metacarpal bone, along the cubital side for the entire of its length, till it approaches the

phalangar end of the bone ; when it is to be continued, with a gentle curve, along the dorsum of the hand, then between the fourth, and fifth fingers, and prolonged by the palmar and cubital surfaces of the little finger, till it meets with the original incision. The edges of the wound being separated, and the soft parts dissected from the bone, the operator may remove it, by cutting through the ligaments which connect it to the os unciforme. By this operation, two flaps are procured, one dorsal, and one palmar. In some instances, the surgeon may be able to preserve the base of the metacarpal bone, which will protect the insertion of the extensor carpi ulnaris tendon.

Amputation of the middle, and ring Fingers, in their carpo-metacarpal Articulations. This operation is much facilitated by ascertaining, previous to its execution, the precise situation of the joint ; which may be always indicated by the following rule :—draw a line, from the carpal end of the metacarpal bone of the thumb, directly across the dorsum of the hand, to the centre of the metacarpal bone, that is to be extirpated ; here, the articulation will be found : a little above this point, the operation may be commenced, by making a \wedge shaped incision, that descends on each side of the bone, to the finger, the operator will then free it from the soft parts, situated in the interosseous space, also from those in the palm of the hand, and remove it;

the vessels being secured, he will approximate the remaining fingers to each other, when very little deformity will be apparent.

Observation. This operation affords us a certain method, of extirpating either of these bones : but, unfortunately, it will not enable us to ascertain, *a priori*, if disease exists, in the carpus ; as happened, in one case, to M. Langenbeck, who, after having extirpated the bone, found the carpus engaged in the disease.

The surgeon who undertakes this operation, must be prepared for very harassing work, when he is about to disarticulate the bone, as, it is so firmly wedged into its situation, that both patience and caution are requisite for this purpose, to enable him to effect it, without serious injury to other parts ; for should the knife be passed too deep into the palm of the hand, in the attempt to remove it, the deep palmar arch of arteries will, in all probability, be divided ; which, it may be difficult to secure, as it is at some depth, and situated in a narrow, unyielding wound.

If it is the third metacarpal bone, which requires to be extirpated, much assistance will be procured, when extirpating it, if the surgeon will avail himself of the extensor carp. rad. brevior, that is inserted into the head of this bone. In cases where the bone is diseased, near the phalanges, it will be preferable, to saw it across, by means of the chain saw, or cut it with a strong bone nippers, posterior to the disease, than to disarticulate it ; which is always a very tedious business, and deprives the patient of the use of the extensor carpi radialis brevior muscle, which must be cut away from its insertion.

Amputation of all the Fingers in the metacarpo-phalangar Articulations. Having pronated the affected hand, suppose it is the left, the operator will take hold of the fingers, and examine for the metacarpo-phalangar joint of the index finger, where he will commence the incision, at its anterior and external side; and carry it across the points at which the fingers are attached to the metacarpal bones, to the internal side of the joint of the little finger. This incision should be convex, the convexity looking forwards; he will next proceed to open the different articulations, by short touches of the knife, which will enable him to pass its flat side, under the heads of the phalanges, when the hand being placed between supination and pronation, he will divide the soft parts, on the palmar surface, going from the radial, to the ulnar side, directed by the groove, that terminates the metacarpal portion of the hand, towards the fingers; and form the palmar flap. If the operation is to be performed on the right hand, it ought to commence, at the cubital side, and proceed to the radial; this plan of operating is also applicable to two or three fingers. On the young subject, as the epiphyses, at the ends of the metacarpal bones, are not yet consolidated, they may be cut through, which will afford an increase of flap.

Amputation of the Hand in the carpo-metacarpal Articulations, preserving the Thumb. If it is the right hand, the operator will place it in

the supine position, and *v. v.* for the left: the thumb being abducted from the fingers, an angle is formed between it and the index one, from which the incision will commence, and pass across the palm of the hand, (if it is the right), to the cubital side of it, with a gentle curve, the convexity looking towards the fingers; the incision should penetrate, at one stroke, to the metacarpal bones; the surgeon will then dissect back the flap, to the carpo metacarpal joint; on the dorsum of the hand, he will also make an incision across it, about a quarter of an inch anterior to the articulation, which will divide the skin and extensor tendons, to the bones; having retracted both flaps, and examined for the lines of the articulation, he may either disarticulate the metacarpus, or, if the state of the parts will admit of it, saw this portion of the hand, a little anterior to the joint: by which proceeding, the insertions of the flexor carpi rad., with the extensor carpi rad. longior, and brevior muscles, will be preserved, also the extensor carpi ulnaris muscle. The surgeon will then secure the vessels, which will be found in the palmar flap, and unite the wound.

Observation. In few departments of operative surgery, is the ingenuity of surgeons more displayed, than in those minor amputations, on the hand, also on the foot; we daily observe them, in cases of accidents, examine what parts can be spared, and amputating those

alone, which are irrecoverably lost, happy, if they can preserve for the patient, the use of the carpus, and but one finger; which he can afterwards avail himself of, in a variety of ways, which no mechanical apparatus could ever supply. Hence the student ought to exert himself, to attain a complete knowledge of this piece of anatomy, so as to be able to offer every assistance to those who may require it of him.

Amputation in the Wrist Joint. First plan, or the circular operation. The circulation being commanded, by compressing the brachial artery, in the middle of the arm, as it passes over the insertion of the coraco-brachialis muscle; the operator places the hand between supination and pronation, while an assistant retracts the integuments as much as possible, and fixes the forearm; one inch below the styloid process of the radius, the surgeon commences the incision, with a small amputating nife, and by a rapid circular motion, divides the integuments around the joint, the assistant continuing the retraction; the operator next seizes the hand, and depresses it towards the ulna, and divides the external lateral ligament, the tendons of the thumb, likewise all those of the hand, and remaining fingers, and in this manner, he crosses through the articulation, from the radial, to the ulnar side, and removes the hand.

The radial, and ulnar arteries, situated at the

anterior part of the joint, being secured, the flaps are next to be placed in apposition.

Second plan. After the situation of the styloid processes of the radius and ulna are marked out, the operator takes hold of the hand, and with a scalpel, makes a semicircular incision from one, to the other, on the dorsum of the hand, the convexity of which regards the fingers, he then raises the flap, and confides it to the care of an assistant, and divides the tendons that run on the posterior part of the joint, opening, at the same time, the capsule: he continues the operation, by making a second flap, from the soft parts that are situated on the palmar surface of the wrist, and finishes it, by cutting through the lateral ligaments, and whatever tendons connect the hand to the forearm.

Third plan, or M. Lisfranc's operation. The hand being supinated, the operator will pass from the styloid process of the radius, to the ulna, a straight, narrow scalpel, through the soft parts on the anterior part of the joint, and will cut downwards, and outwards, so as to form a flap, an assistant will raise it; when the anterior part of the articulation, will be found to be laid open; which will easily be traversed from before backwards, by the surgeon; who will terminate the operation, by forming the second flap from the soft parts on the dorsal side of the wrist.

Observation. Of these three operations, the last is the only objectionable one, as the knife will be found to traverse with difficulty, the tendinous, and aponeurotic textures, which surround the joint, and a flap will result, composed partly of those tissues which are not much disposed to take on the adhesive inflammation; in many instances the parts will be so dense in consequence of repeated attacks of inflammation, that the operator may find it necessary to repeat the plunge of the knife, in order to make the requisite section of the soft parts. The circular incision is the most rapid of execution, and leaves the parts in a very good condition for adhesion, as neither tendon nor ligament can enter into the line of junction formed by the flaps.

The second plan of operating is very easily executed; it affords two very good flaps, and is known to many surgeons by the name of the tench's mouth operation.

When detaching the wrist from the forearm, after the division of the integuments, the surgeon should be attentive to preserve the integrity of the fibro-cartilage, that connects the radius to the ulna, as I have often observed pupils cut it away, when practising these operations, and particularly, if they commenced the disarticulation from the ulna to the radius. This accident may be always prevented by keeping the knife close to the convexity of the carpus, and dividing the parts from the radius to the ulna. The disadvantage that results from such an accident is, that the union of the two bones is considerably weakened; they are also liable to be dislocated from each other, in forced pronation and supination. In severe accidents, when much of the soft parts have been destroyed, this operation may be well performed

with only one flap, which is to be made from the uninjured soft parts, whether situated on the posterior, or anterior part of the joint.

Before uniting the lips of the wound, the remains of the synovial membrane, and the cartilages which cover the radius, should be scraped off, as it will completely arrest the synovial secretion, and expedite the absorption, of any of the cartilaginous structure of the bones ; if this trifling precaution is neglected, union will be very slow in taking place.

The propriety of this practice was fully established in some cases of this operation, which were performed in Mercer's Hospital a short time since ; in all those, in which the synovial and cartilaginous structures were removed, union took place in a much shorter time, than when they were allowed to remain, to undergo the process of absorption.

Amputation of the Forearm. Surgeons have the choice of either the flap, or circular method, for removing this extremity, when it is performed at the inferior third of the limb. British surgeons generally prefer the flap operation, and do not hesitate to take it off, at this place, being always satisfied of having a well-formed stump to cover the bones ; whilst the Continental surgeons, and particularly the French, object to the operation so low as this part of the forearm, as they conceive so much tendinous, and fibrous structures enter into the flap, that the process of union will not proceed favourably : they also dread the formation of abscesses, with the ex-

tension of sinuses along the tendons, and the protrusion of the bones; as consequences to the operation in this situation. This opinion doubtless arises, from the manner that they treat the stump after the operation, as they cover it with charpie, and scarcely ever attempt union by the first intention; which, from the uniform benefits that result from it, will be the only way to remove their opposition to amputation in this part of the forearm, and will also dispel their fears, as to the formation of abscesses.

Amputation with two Flaps. The forearm having been extended, and placed between supination and pronation, an assistant will command the circulation, as already indicated, p. 145; a few lines below the point, where the operator intends sawing the bones, he will grasp the limb, between his thumb and fingers of the left hand, and directed by the thumb, will pass the kind of catlin recommended in this work, from the radial to the ulnar side of the arm, (for the right, and *v. v.* for the left member,) on its anterior surface, perpendicular, and close to the bones, and will cut downwards, parallel to them, till a sufficient quantity of soft parts are divided to form the flap, which he will complete by bringing the knife out through the skin.

The catlin will be again introduced by him in the angle of the wound, at the external side of the forearm, and passed through the limb, till it appears at the ulnar side of it, in the solution of

continuity, made by the first incision; to effect this point, with facility, it will be requisite to supinate the arm a little, as the knife is being passed towards the ulna; by this trifling manœuvre, the second, or posterior flap, will be easily made.

The operator will then reflect the flaps, and divide the interosseous ligament, with the soft parts situated between the bones, and pass the centre tail, of a three-tailed retractor, through the interosseous space, so as to protect the muscles; having pronated the arm as much as possible, he will saw the bones, completing the section of the radius before the ulna, as the ulna can better bear the weight of the saw, being more firmly articulated with the humerus.

The radial and ulnar arteries, will be found in the anterior flap, which ought to be secured as high as possible, as they have been cut obliquely; it may be also necessary to tie the anterior and posterior interosseous vessels, which will be seen to run close to the ligament of the same name. If the tendons, or nerves, project beyond the flap, they are to be cut short, otherwise they will interfere with the union of the wound. This operation may be reversed, and the flap made by cutting from without inwards, and from below upwards; it demands some practice to operate skilfully in this manner:—whilst M. Lisfranc recommends, the flaps to be made in the following way; the hand being placed as already di-

rected, he commences the operation from the ulna, to the radius, by passing the knife from the inner to the outer side of the arm, to form the first flap; to make the second, he enters the instrument from the radius to the ulna; he supposes this plan occupies less time, than the method just described: it does not appear to me to possess any advantage over the usual mode of operating.

Amputation of the Forearm, by the circular Operation. The limb being circumstanced as in the last operation, let an assistant retract the integuments as much as possible, whilst the operator, standing on the inside of the arm, makes a circular incision, through the skin, which is to be still retracted, and separated from the subjacent parts by dissection, for one inch, or more in proportion to the size of the limb; (dissection is actually necessary for this purpose, as the skin is so adherent to the fascia, it will not otherwise retract,) the edge of the knife he then applies as high as the retracted skin will admit, and inclines it, obliquely upwards; when at one sweep, the muscles are to be divided to the bones, from which the operator dissects them, till it is obvious a sufficient flap will be obtained for a covering; the interosseous ligament is next to be divided, when he finishes the operation as in the preceding case.

When the circular operation is performed high up on the forearm, after the superincum-

bent soft parts have been divided in the way just described ; to cut the substances placed deep between the bones, M. Dupuytren recommends the following manœuvre, pass the knife on its flat side, along the anterior surfaces of the radius and ulna, it now has all the soft parts situated on the surface of these two bones, anterior to it, which are to be divided by elevating the edge of the knife ; the same manœuvre is to be performed at the back of the arm.*

Amputation of the Forearm in the humero-cubital Articulation. This operation appears to have been first performed by Ambrose Paré, and soon fell into disuse ; it has been lately revived by M. Dupuytren, and, I understand, with considerable success. It is executed in the following manner, with great facility :—having commanded the circulation, and flexed the forearm, about one-third, the operator passes a catlin from the external to the internal condyle of the humerus, on the anterior part of the joint, and in close apposition with it, and carries it down along the forearm, for a sufficient distance, to form a flap from the parts, situated on this aspect of the limb ; having elevated it, he next connects the internal angle of the wound with the external one, by a half circular incision, on the pos-

* *Vide Med. Oper. par Sabatier, tom. iv. p. 496.*

terior part of the articulation ; all that now remains to be done, is for him to divide the capsular and lateral ligaments, when he has it at his option, either to saw through the olecranon process of the ulna, which preserves the insertion of the triceps extensor cub., or he may dissect it from this attachment. The synovial membrane and articulating cartilages, covering the condyles, are next to be removed, and the artery, which will be seen lying on the brachialis anticus, towards the inner side of the arm, secured, after which the flap is to be laid over the end of the humerus.*

Observation. By a trifling modification, this operation may with much advantage be adopted, for amputating the inferior part of the humerus ; for example, in place of passing the catlin parallel to the condyles of the humerus, it should enter about two fingers' breadth above these processes, and cut its way downwards, and outwards, towards the hand, to form the flap ; after it is made, the angles of the wound are to be connected, by a half circular incision, passing on the posterior part of the arm, which will divide all the soft parts, to the bone ; the muscles are then to be protected by means of a retractor, and the humerus sawed immediately above the condyles ; when the artery is to be secured, and the flap brought over the bone, which will form a thick full cushion for it.

* *Vide Med. Oper. par Sabatier, tom. iv. p. 524.*

I have thought it proper to advocate this operation, as it will, I am confident, in many cases supersede the usual one performed on the humerus; the surgeon will also find it of very easy execution.

Amputation of the Humerus, by the circular incision. This operation is generally considered as confined to the space between the elbow, and insertion of the pectoralis major muscle; if the affection demanding it, extends higher than this point, the limb can alone be removed by a flap operation; indeed some surgeons go so far as to operate at the shoulder joint; this is too severe a proceeding, as it will be immediately shewn that it is preferable to divide the pectoralis major and other muscular attachments, and saw the bone below the tuberosities, than resort to amputation below the shoulder joint.

The patient is generally seated on a chair, with the arm in the extended position, and supported by an assistant, who can also compress the artery, in the middle of the arm; or the tourniquet may be used for that purpose: the skin being retracted, and the operator standing on the outer side of the limb, carries his hand under it, armed with the middle-sized amputating knife, and makes a circular incision through the skin to the muscles; the integuments are then to be retracted, but not dissected, from the subjacent parts, as a few touches of the knife are sufficient to divide whatever slips of cellular membrane

that connect them to the muscles; at the place where the skin has been reflected to, the surgeon again applies his knife, commencing external to the biceps muscle, and divides the muscles and vessels, cutting them obliquely upwards; he will find it necessary, to make a second incision close to the retracted muscles, to divide the remaining soft parts to the bone; after which he detaches from it the muscles, for the space of an inch, or an inch and a half, or in proportion to the size of the limb; he then protects the soft parts by a retractor, and saws the bone; the vessels next demand his attention; the principal one, will be found internal and a little anterior to the humerus; and one or two at the external side of the stump.

Amputation in the same situation, with a double Flap. The surgeon seizes upon the arm, and retracts the skin, indicating with his thumb the point where the catlin is to enter, and passes it from the external to the internal side of the humerus, close to the bone, and forms the anterior flap first, by cutting downwards and outwards, for a sufficient distance; he then makes the posterior one, in a similar manner, by introducing the knife at the back of the arm; having reflected the flaps, and defended them with a retractor, he saws the bone close to their base, secures the vessels, and finishes the operation.

Amputation of the Humerus above the insertion

of the deltoid Muscle. The patient sitting on a chair, with the limb extended from the body, to nearly a right angle, an assistant compresses the subclavian artery, as it passes over the first rib, by means of his fingers, or the handle of a tourniquet, well padded and placed obliquely across the vessel; or the manner recommended by Mr. Guthrie may be adopted, viz.: apply a firm compress on the course of the artery, in the axilla, and confine it by the strap of the tourniquet, which is to be carried over the acromion scapulae; the screw is then turned till the circulation is controlled. This method of applying the tourniquet is very advantageous, and will scarcely interfere with the retraction of the muscles.

First plan. It consists in forming a trapezoid shaped flap, from the deltoid muscle, and may be executed in the following manner: the arm being raised, and the insertion of the deltoid ascertained, a little above it, a transverse incision of from two to three inches long is to be made, through it, down to the bone; it is then necessary, to let fall two incisions, parallel to each other, and perpendicular on the ends of the first, also through the skin and muscles to the humerus; the flap resulting from these incisions, is to be detached, and reflected from it; from the base, or attached part of which, a half circular incision is to pass on the internal side of the limb, till it

meets the bone, having retracted the soft parts from it; the humerus can be sawed, at a little distance below its tuberosities.

The axillary artery will be instantly recognised by its open mouth, at the internal side of the stump, which can be seized with a forceps and drawn gently out, in order that it may be secured; one or two minor vessels may also demand a ligature; the surgeon should be cautious not to allow any of the nerves to get into the line of union.

Second plan. The patient being seated on a chair, and the subclavian artery compressed; the student, by referring to the last operation for the shoulder joint, will find the principles of this method there described; which he is to adopt, with some modifications for this amputation, *e.g.* in place of commencing this operation immediately from the acromion, he begins it a short distance below that process, (about two inches,) and proceeds in the subsequent steps, as if it was his intention to amputate in the shoulder joint. After the bone is laid bare, and the flaps retracted, (he ought not to clear away too carefully, the tendons of the latissimus dorsi, and teres major, from it, as they help to keep the bone steady under the action of the saw.—*Guthrie.*)

The bone is then to be sawed, and the nerves prevented being placed in the lips of the wound, which will extend from the acromion downwards towards the axilla.

Observation. These two operations, allow the application of the saw from one to one and a half inch below the tuberosities of the humerus, by which the fullness of the shoulder is preserved, and all deformity is obviated; both are of very easy execution.

Amputation in the Shoulder Joint—or Scapulo-humeral Articulation. Surgeons are indebted to Le Dran the father, for directing their attention to this operation; who performed it on a French nobleman, with success; since whose time, few operations have exercised the ingenuity of medical men, with a view of improvement, more than this, and is now brought to such a state of perfection, that its successful termination equals, if not exceeds, that of any other amputation.

A perfect acquaintance with the anatomy of this joint is so important, not alone to enable the student to adapt his operation to the necessities of the case, but also, to extirpate the head of the humerus, when required, that I have appended after the different plans of this operation, a concise description of it, which the student is advised to peruse preparatory to their execution.

The facility with which the axillary artery may be commanded, by making pressure on the subclavian, above the clavicle, is now so well known, to every tyro in the profession, that no argument, or case, is necessary to enforce it; the compression ought to be always made above the clavicle, where nothing intervenes between the

vessel, and the means employed, but the skin, platysma myoides, and cervical fascia.

If it should be attempted below this bone, there will be the thick and strong pectoralis major, resisting our efforts ; there is also a chance of compressing the artery, against the intercostal muscles in place of the second rib : Mr. Guthrie's advice is well worth bearing in mind, concerning the compression of this vessel, viz., not to attempt it, till the limb is placed in that situation, which the operator deems fit to commence the operation ; since the slightest change in the position of the arm, will alter the compressing power, and baffle the attempt made to arrest the flow of blood ; he, with many others, recommend either the ring of a large key, or the handle of a tourniquet, well padded with lint, and placed obliquely across the course of the vessel, as it runs over the first rib. These instruments may be used, where the surgeon cannot implicitly confide in the assistant, who has charge of the circulation ; but, where he can depend on him, it is preferable to follow the injunctions of that very interesting, and practical writer, Mr. Hennen, who condemns the use of boot-hooks, keys, or tourniquets, for this purpose ; and remarks, that the patient, more frequently complains of the pain arising from the pressure of such instruments, than from the operation itself ; he justly observes, that compressing the vessel, is one of the principal parts of the operation, and advises

it to be made, at the moment, when the vessel is being divided ; this can be always accomplished with the thumb ; and the surgeon can also remind his assistant of his duty, prior to cutting the artery, and nerves, which is the last step of the operation ; indeed, in most cases, he can command the vessel himself, by seizing the soft parts, on the inner side of the humerus, with his left hand, before he makes the final section which is to remove the limb from the trunk.

LE DRAN, who first performed this operation, commenced it by securing the axillary artery, which he accomplished by plunging a needle, armed with a ligature, through the integuments in the axilla, and included in it the axillary vessels, a portion of the muscles, and of the skin, which was secured upon a compress ; he then made a flap from the deltoid muscle, luxated the humerus, and divided the soft parts on the internal side of the arm, immediately below the ligature. As it is my intention, to describe only those methods, which can be made most available to the different maladies, that call for this operation, I beg to refer the student, to Sprengle's *Histoire de la Medicine*, and to the works of MM. Larrey, Guthrie, Sabatier, and Hennen, for a full detail of the numerous plans that have been resorted to, for this amputation.

First plan. M. LA FAYE'S *Operation*. The patient being seated on a chair, and the arm, if possible, raised horizontally, the operation is to

be commenced, by making, with a common bistoury, about four fingers' breadth below the acromion process, a transverse incision, three inches long, through the deltoid down to the bone; two other incisions, one anterior, and the other posterior, are to meet the extremities of the first, falling perpendicularly upon it; by this means, a large flap is obtained, the shape of a trapezium, which is to be detached from the neighbouring parts, and elevated on the shoulder. The two heads of the biceps, the tendons of the supra and infra spinati muscles, of the teres minor, and subscapularis, are now seen, and are to be divided, which is greatly facilitated by rotating the humerus, which brings the insertion of these muscles, more under the knife, at the same time the capsule of the joint is laid open. It is now an easy matter to dislocate the bone, and draw the head outwards by using it as a lever of the first order, when space will be procured to pass the bistoury from above below, along the internal part of the humerus, so as to separate the soft parts from it, till the axillary vessel is felt, which is to be secured as close as possible to the axilla. The limb is then removed, by dividing the remaining connexions, a finger's breadth below the axilla. The ligatures are to be arranged, and the flap laid over the glenoid cavity.

Second plan. BARON LARREY'S *improved Method*. The arm is to be elevated to a moderate degree, from the trunk, and a vertical incision made from the point of the acromion, downwards

through the deltoid, for three or four inches penetrating to the bone, which divides the muscle, for the entire of its extent, into two equal parts. The posterior lip of this incision, is next to be drawn from the humerus, and a catlin plunged between it and the soft parts, till the point appears, immediately below the conjoined tendons of the latissimus dorsi, and teres major muscles; so as to cut its way obliquely, from about two inches below the acromion, to that point, where the posterior fold of the axilla joins itself to the arm. The knife is next to be introduced, between the bone, and muscles, at the anterior part of the arm, and the point brought out below the inferior edge of the anterior axillary border, that a flap may be made as in the posterior one; an assistant having retracted the two flaps, at the same time compresses with his fingers the circumflex arteries. Whatever parts are situated on the anterior, posterior, and external sides of the joint, are now exposed, such as the capsular ligament, with the tendons covering it; these are readily divided; which allows the knife to pass over the head of the humerus, and arrive at the internal side of it, which is to be separated from the soft parts, by cutting down close to the bone, for a sufficient extent, as to permit the assistant insinuating his thumb between the humerus and soft parts at the inner side of the arm, to seize on them and compress the artery; while the remaining soft parts are being divided, that the limb may be separated from the trunk.

Third plan. M. DUPUYTREN's *manner of operating*. According to the first, the arm is a little elevated from the body, while the surgeon stands behind the patient, if it is the right arm which is to be amputated, and *v. v.* for the left, and lays hold of the deltoid muscle, with the soft parts that cover the humerus externally; and having raised them from the bone, he introduces a catlin under them, immediately below the acromion, which is to run upon the humerus; when with one sweep of the knife he cuts downwards and outwards, to make the external flap; which, according to La Faye's operation, required three incisions to form; the articulation having been exposed, he next divides the tendons, and other parts connected with the head of the bone, which enables him to carry the knife to the inner side of it; before finishing the section of the parts, at the internal side of the arm, an assistant or the surgeon compresses the axillary artery. This proceeding gives us two flaps, one at the external and superior part, the other, at the internal and inferior part of the glenoid cavity, which are not the most favourably situated for union, as will be more particularly explained below.

Fourth plan. M. DUPUYTREN's *second method*. He elevates the arm to a right angle with the trunk, and places the heel of a common amputating knife, a very little way below, and before the acromion process; then, with one stroke, he divides the skin and muscles on the back part of

the shoulder to the posterior border of the axilla, while the flap is being elevated by an assistant, M. Dupuytren carries the elbow forwards across the trunk, which causes the head of the humerus to protrude posteriorly, and cuts boldly through the tendons and capsule, on this side of the articulation, opening into the cavity of the joint; he then passes the knife round the head of the bone, from behind forwards, and completes the operation, by making the anterior flap, cutting from within outwards, secures the vessels, and approximates the lips of the wound.

Fifth plan. *The operation of LISFRANC and CHAMPESME.* The arm is allowed to hang parallel to the trunk, which separates the head of the bone, from the glenoid cavity, while the surgeon stands in front of the patient, and seizes the thick part of the shoulder, to draw it from the humerus, he then plunges a long, double-edged, narrow knife, into the triangular space, situated between the coracoid process, the acromion, and the head of the humerus, from before backwards, at the same time traversing the joint, till the point of it appears about half an inch below the place, where the acromion twists on itself, and ceases to be horizontal; after which he cuts upwards and outwards, passing over the head of the bone, till he arrives on the external part of the humerus, and forms a deltoid-shaped flap, from the muscles at the superior and posterior part of the shoulder. When the flap is elevated, if this step of the operation is properly performed, the joint is

found to be opened ; which the surgeon traverses from without inwards, and finishes the operation, by making a flap from the muscles on the internal side of the humerus.

Sixth plan. M. LISFRANC'S *Operation*. The shoulder joint amputation, known as that of M. Lisfranc, differs from the preceding only in a few particulars.

The operator always stands behind the patient, whether it is the right or left arm that is to be amputated ; having separated it from the trunk, for three or four inches, he takes hold of the thick fleshy part of the shoulder, to raise it from the bone ; and introduces a long, double-edged knife (eight inches long, and not more than eight lines wide at the handle,) parallel to the humerus, and through the posterior fold of the axilla, a little anterior to the tendons of the latissimus dorsi, and teres major muscles, which he passes obliquely upwards, along the posterior and external surface of the humerus, till it arrives between the arch of the acromion, and the capsule of the joint ; he next separates the handle of the knife for two or three inches from the arm, and pressing upon it, forces the point into the triangular space, mentioned in Champsme's operation, by traversing through the joint, and cuts principally with that part of the knife near the point, from within upwards and outwards, so as to clear the head of the bone ; as soon as this is effected, and the knife, near its point, is

disengaged, from between the head of the humerus, and the acromion, the operator cuts with it, along the external side of the arm, to complete the flap, at the distance of three inches from the joint.

When the flap is elevated, the articulation is perceived to be freely opened on its posterior aspect, and the arm separated to some distance from the glenoid cavity, as some of the small scapular muscles, and long tendon of the biceps have been divided. To form the second flap, the operator enters his knife into the joint, where it has been opened, at the same time keeping his hand low, and cuts from heel to point, going from behind forward, around the internal side of the head of the humerus, and brings the handle of the instrument perpendicular to the horizon, the knife all this time passing along the bone, to the extent of three inches below the articulation. Before detaching the arm from the trunk, an assistant compresses the artery.

In this operation, the posterior and superior flap is composed of the external extremities of the latissimus dorsi, teres major, and minor muscles, also of portions of the supra and infra spinati m., the long heads of the biceps and triceps, all the acromial part of the deltoid, and almost all that part of it, that is attached to the clavicle, external to the coracoid process of the scapula.

The anterior, and internal flap, consists of the

remaining part of the clavicular portion of the deltoid, the pectoralis major, the coracoid portion of the biceps, the coraco-brachialis, a part of the triceps muscles, with the axillary vessels, and nerves.

If the right arm is to be removed, the operation must be performed with the left hand of the surgeon ; or it will be found more convenient, to adopt that of Champsme, as few possess sufficient dexterity to use the left hand according to Lisfranc's plan.

Seventh plan. The shoulder joint amputation, as generally performed by British military surgeons.*

This operation can be performed in the following manner, with ease and facility, by which two flaps will be obtained, and a good cushion formed.

The patient being seated upon a low chair, and supported by an assistant, to prevent his yielding during the operation, who will also compress, or ascertain that he can effect the compression, of the subclavian artery, *at will*, above the clavicle, with his thumb. The surgeon ought also to satisfy himself, that his assistant can command the circulation in the vessel, by feeling for it in the axilla ; if he perceives the pulsation to be arrested, during the compression, he

* *Vide* Guthrie on Gunshot Wounds, p. 428. Hennen's Mil. Surgery, p. 262.

may be confident, that no blood flows through the artery. The axilla being previously shaved, the surgeon then proceeds in the operation, by raising the member from the side of the trunk, sufficiently high, as to indicate the folds of the axilla, below which the incisions are to extend, and makes from the point of the acromion process, to the centre of the axilla, on each side, with a gentle curve, the outline of the flaps, first on the anterior and inside, and next on the posterior and outside, of the arm, by dividing the integuments and cellular membrane, with a large scalpel; the posterior flap ought to be always a little larger than the anterior; the retraction of the skin being favoured by an assistant, the surgeon, with the common amputating knife, next divides, on the anterior part of the limb, a portion of the deltoid, and the pectoralis major tendon, which exposes the coraco-brachialis muscle; this incision ought not be carried deeper for the present, as the nerves and arteries, will incur some danger, if it is. The division of the pectoralis tendon renders the motion of the arm very free: on the posterior part of the shoulder, the remainder of the deltoid, with a portion of the triceps extensor cubiti, must be then divided, and the small tongue of the deltoid, that intervenes between the incisions, is to be cut from the acromion, and laid down upon the humerus; by which the head of the bone, the small scapular muscles, and capsular ligament, are exposed;

the surgeon then enters the capsule by running the scalpel along the bicipital groove, as on a director, and is immediately conducted by it, into the joint; he then divides the long tendon of the biceps, the supra and infra spinati muscles, also the teres minor, and luxates the bone by throwing the arm backwards; or, if he can depend on his anatomical knowledge, after the formation of the flaps, he orders them to be reflected on each side, and cuts fearlessly on the head of the humerus, through the tendons attached to the great tuberosity, also through the capsular ligament, and enters directly into the joint.

The head of the humerus being now free, the knife is to be passed over it, to the internal side, and the subscapularis tendon separated from it; which allows considerable motion to the head of the bone, and permits the surgeon to draw it outwards: who, as he is now about to accomplish the most hazardous step of the operation, either takes charge of the artery himself, by compressing the soft parts, in which it is placed, between the thumb and fingers of one hand; or calls the attention of his assistant to it, and with the other carries the knife down along the bone, for a very short distance, when, with one stroke of it, he connects the two flaps, and severs the limb from the trunk, by dividing the rest of the triceps, the latissimus dorsi, and teres major muscles, also the coraco-brachialis, with the nerves, the vein, and artery.

The surgeon next proceeds to secure the vessels, and finds the axillary presenting its open mouth, in the inferior third of the wound ; while the anterior circumflex artery, will be met with in the anterior flap, and the posterior circumflex in the opposite one : he finally approximates the flap, and dresses it.

Observations. Seven operations have been fully described, which, however, do not embrace all the varieties that may be included under the history of this operation ; still I trust that the most important are brought forward, and such as, with the anatomy of the parts concerned, will enable the young surgeon to meet any difficulties that may occur ; for in most cases he will find that any of them will demand some modification.

M. La Faye's operation, presents many advantages, though consisting of but one flap ; it is equally applicable to both arms, and may be performed with much facility ; no blood is lost, as the artery can be always commanded by the operator, before the limb is separated from the trunk ; a large fleshy flap is formed, which will amply cover the glenoid cavity, though extending over the long diameter of its surface ; however, it is limited in its adoption, to such cases, as present us with the deltoid muscle uninjured, or in a very trifling degree.

M. Larrey's plan is supposed by many, to consist of three flaps ; an anterior, middle, and posterior ; this opinion results from an erroneous idea of the operation, even as described by the Baron himself ; it, in reality, consists but of two, separated at the acromion, by a very small space, and united below, in the centre of the axilla. It

requires some dexterity, and repeated practice, to form two well-proportioned flaps, by this operation; it has fallen to my lot, to witness three, in place of two, to be made by students, when practising it; it is a proceeding which I would not recommend as a first trial on the living: if it be selected, the surgeon can command the haemorrhage, by placing his thumb into the wound, and fingers in the axilla, and compress the vessel; which will add to the security of the pressure exerted by the assistant.

Dupuytren's first plan does not form so good a flap as that of La Faye's; it is very liable to retract, and uncover the glenoid cavity. The second method is remarkable for its celerity in performance, and affords two full fleshy flaps, anterior and posterior, which are easily retained *in situ*: provided the motions of the joint are free, and not much injured, it is the most expeditious way of amputating at the shoulder joint, and can be readily attained by the most inexperienced operator.

Champesme's and Lisfranc's operations, to the practised hand, are quickly executed, leaving a flap superior and external, another internal and inferior; the first is thin and poor, the second is always the fullest, but is retained in apposition with the glenoid cavity, contrary to its gravity; the consequence of which is, it will separate from the other, and matter, in all probability, form; the manner of performing it will always oppose its adoption; as it is effected by stabbing, which is not easily carried into execution, and in most cases it is a difficult matter to hit off the parts indicated, so as to traverse the joint with facility; if they are missed, the attempts are to be again and again renewed; those repeated

thrusts of the knife, throw the muscles into severe spasmodic action, and do not certainly expedite the operation; consequently, the sufferings of the patient will be increased. It also requires a particular knife, which is never found in an amputating case. In my opinion it is the one least worthy of adoption.

The last operation is well suited for selection; if it does not admit of so much celerity in the performance as some of the preceding methods, the delay is counterbalanced by the benefits derived from two very good flaps, which can be retained in apposition, without any difficulty, a line merely forming their union; it is particularly applicable to a first attempt on the living subject.

Anatomy of the Shoulder Joint. Two bones enter into the mechanism of the scapulo-humeral articulation; the head of the humerus, and glenoid cavity of the scapula, which bear no proportion to each other, in their articulating surfaces; the first presents a segment of a sphere; if examined, it will be found, in its perpendicular direction, to be twice as long, and in the transverse, three times that of the glenoid cavity, which is of an oval form, the greatest diameter being from above downwards, and is double the extent of the transverse one. These bones are united, by a large, lax, and weak capsular ligament, attached above to the neck of the scapula, below to the anatomical neck of the humerus; it is strengthened by an accessory band of fibres, named the coraco-humeral ligament, which stretches downwards and outwards, from the coracoid process, to be inserted partly into the capsule, and partly into the humerus; it is also strengthened by the muscles inserted into the great tuberosity of the humerus: the long tendon of the

biceps muscle passes through the capsular ligament, being also lodged in a groove, presented to it by the humerus, and is attached to the superior point of the glenoid cavity, where it is continuous with the glenoid ligament.

The long tendon of the biceps, and the bicipital groove of the humerus, are of much practical use to the operator, in operations about the shoulder joint, as they will conduct him, without the possibility of delay, or mistake, into the articulation; which is protected, superiorly, by the arch formed by the acromion, and coracoid processes, also by the coraco-acromial ligament.

A number of muscles surround the joint; at the superior part, is the deltoid, constituting the principal portion of the fleshy mass of the shoulder, and covers the supra and infra spinati muscles, also the long tendon of the biceps; towards the posterior surface, the teres minor and major muscles, with the latissimus dorsi, are found, also the posterior circumflex artery, and nerve; while at the anterior region, the pectoralis major is seen, and conceals the coraco-brachialis, the short head of the biceps, also the subscapularis muscle: on the inferior aspect of the articulation, the long head of the triceps extensor cubiti, descends from the scapula to the arm; all these muscles must be divided, during the operation. Towards the internal surface of the humerus, the axillary artery and vein, with the brachial plexus, pass to the arm, surrounded by a quantity of lax cellular membrane, into which the vessel retracts when divided, where it is always recognised by its open mouth; in this situation, the anterior, and posterior circumflex arteries arise from it, and will always require a ligature.

By measurement, the distance from the acromial arch,

to the inferior edge of the glenoid cavity, is equal to about two inches and a half, while the transverse extent of this cavity, is not more than one inch ; if to this be added the manner in which the muscles are arranged about the articulation ; the necessity of forming the flaps, in a certain way, provided the state of the soft parts will admit of it, is immediately apparent. They should, consequently, be anterior and posterior, but never superior and inferior, as the increased distance caused by the excess of the long diameter of the articulation, over the transverse one, will prevent the flaps being brought into as perfect apposition, as they can be, by taking advantage of the natural form of the joint. It will also be perceived, that flaps formed in the manner now advised, will be more easily maintained, *in situ*, as no weight will tend to separate them.

Amputation of the inferior Maxilla in part or in totality. This operation is but of late date, and is called for in those malignant affections of the jaw, which have been termed, osteo-sarcoma, medullary sarcoma, and in large exostoses ; it may be also required in gunshot wounds, which produce comminuted fracture, with other serious lesions ; in all probability, such accidents, first led to the idea of removing portions of the maxilla, in consequence of the recoveries that ensued after them.

To enable the operator to plan his operations with precision, and to execute them with safety, and rapidity, also to act with promptitude, and decision in the harassing situations, that opera-

tions upon the lower jaw will sometimes place him in, induce me to give the anatomical details of it, after the operations have been described.

The operation will be modified, according as it is the anterior, or lateral portion; or the whole of the body of the bone, with the ramus, which are affected by the disease. First plan. If it is the anterior part on which the operation is to be performed, the patient being seated on a firm chair, with the head thrown backwards, and supported on the breast of an assistant, who also compresses the facial arteries as they ascend the jaw, anterior to the insertion of the masseter muscles: the operator, placed in front of the patient, then commences his incisions, at such a distance from the disease, as will insure to him, that it is included in the intended removal, and carries them downwards to the os hyoides, where they meet, and form an acute angle; he then dissects back the soft parts from the bone, and completely clears them away from any diseased portion of it; if haemorrhage occurs, it can be easily restrained by an assistant. The operator, prior to sawing the bone, frees its internal surface from the soft parts that are united to it, by a cautious use of his knife, which he keeps close to the jaw, and then saws it upon each side of the disease; which permits him to turn out the diseased mass and remove it. He next secures the labial and any branches of the submental, and lingual arteries, that require to be tied; sponges out the wound,

approximates the remaining portions of the bone, and seeks for union.

Second plan. *The Operation as advocated by M. DUPUYTREN.* The patient being properly situated, an incision is to extend from the centre of the inferior lip, down to the os hyoides; the facial artery being next forced back, upon the masseter muscle, a scalpel is to penetrate the soft parts, anterior to it, and be continued transversely forwards on the bone, till it meets the first incision; on the opposite side of the jaw, a third incision is to be made, similar to the last. Thus, by three incisions, four flaps are formed, which are to be dissected from the bone to their bases, when it will be denuded as far as the rami, and may be then sawed upon a level with them; no injury whatever being inflicted upon the facial arteries, and the operation completed, as in the foregoing one.*

Third plan. When the disease is situated on the side of the bone, and occupies a considerable extent of it, and of the ramus, we will in most cases be able to make a flap from the cheek: the observations of Dr. Cusack, of Steevens' Hospital, who has performed this operation no less than seven times, six of which have been successful, are so highly important, and deserving of so much attention, that I do not hesitate to

* Dic. des Sciences Med. tom. xxix. p. 431.

make a liberal use of them for my present purpose to form data for this operation.*

All teeth, the removal of which are necessary, to permit the division of the bone, are to be extracted, the day previous to the operation, and the patient seated as already described.

Three incisions are perfectly adequate for the purpose of exposing the bone, even when the body and the ramus are engaged in the disease. The first and anterior, or mental incision, passes from the angle of the mouth downwards, to clear the base of the jaw, and varies according to the extent and situation of the disease; perhaps it is never necessary to continue it farther below the base of the jaw, than is sufficient to lay bare a sound part of the bone, and give free room for its division, which may be effected in some instances by a small hand saw; but the difficulty of protecting the soft parts from laceration, and the interruption occasioned by the restlessness of the patient, often renders the use of the chain saw more expedient. Some delay is likely to be met with in introducing this kind of saw; and afterwards, from the liability which the instrument has to become 'locked:' practice, however, enables the operator to overcome these inconveniences. The flat curved needle, used for the introduction of the saw, must be sufficiently wide to make an opening for the passage

* *Vide Dublin Hospital Reports, vol. iv.* for his cases.

of the instrument; the point is to be introduced from below upwards, and kept close to the bone, to avoid wounding the neighbouring vessel. The chain saw ought not to be above fifteen inches long, but much stronger than those commonly in use; more than one should be provided, to prepare against accidents; and the operator should endeavour to render himself expert in the use of the instrument, by previous practice, which is best accomplished, by working the saw in as straight a line as possible, so as to allow no curve in it.

The bone being sawed, the next incision, the posterior, or aural one, if a large portion of the jaw is to be removed, commences a little anterior, and superior to the lobe of the ear, and is to be continued down to the angle of the jaw, being carefully kept within the line of the bone, so as to avoid wounding any neighbouring vessel, and is then prolonged into the third or inferior incision, (which may be also named the horizontal,) which, with a gentle curve, courses *about a quarter of an inch above the base of the jaw*, so as to join the first incision.

If necessary, the facial artery is now readily secured; but when this vessel is divided, by an incision passing along *the edge of the bone*, its retraction within the cellular substance, behind the jaw, causes much delay and loss of blood. When the flap is dissected up, the parotid gland, if not removed by absorption, or obscured by the disease, comes

next into view, and may be saved by a little care, and dissected back ; the masseter muscle is then to be separated from the bone, and the large flap formed by these incisions elevated, and confided to the care of an assistant. The ramus of the jaw having been thus laid bare, it is to be divided by means of the chain saw, which is easily introduced, if this part of the bone be free from disease, by conveying it *close to the internal surface* of the ramus, and from the anterior to the posterior edge of it ; but, should the bone be morbidly enlarged, or deeply involved in the disease, the practice of this saw may be impracticable, and the use of a fine metacarpal saw, or one on the principle of Mr. Hey's, may be then necessary. Much circumspection is requisite in using the saw in this situation, so as to protect the gustatory nerve. After the second division of the bone, it is to be pressed downwards and outwards, so as to put the lining membrane of the mouth upon the stretch ; this having been divided, the cellular texture easily gives way, and a very large portion of the bone may be detached, without using the knife.

The next step consists in rotating the bone outwards, at the same time pressing it down, so as to elevate the inferior edge of the maxilla, to enable the operator to divide the pterygoid internus, and mylo-hyoideus muscles upon it, thus avoiding the danger of wounding any of the lingual vessels, or the gustatory nerve. The divided portion of the bone, having been thus freed

from its attachments, is now to be removed. When it is necessary to extirpate the condyle, in addition to the proceedings already detailed, the cut extremity of the ramus is to be seized in a strong pair of forceps, and strongly depressed, to clear the coronoid process from the zygomatic arch, and the attachment of the temporal muscle, divided from it; by which the bone is rendered comparatively moveable, and allows it to be used as a lever, to press the condyle against the anterior and external part of the capsular ligament, which is put upon the stretch. An opening having been made, into the anterior part of it, the disengagement of the condyle can be effected by a blunt pointed bistoury, carried cautiously round the joint, dividing the attachments of the external pterygoid muscle, without any dread of wounding the internal maxillary or temporal arteries, or the gustatory nerve; which is unavoidable, if the articulation is opened in the contrary direction; the ascending branches of the portio dura nerve, may also escape by adopting this manner of entering the articulation.

The second section of the bone, may appear at first view unnecessary, when the jaw is to be removed from the articulation, but the body of the bone is in general so much disorganised, or deeply imbedded in the tumour, that it cannot be used to press the condyle against the capsule. A case might occur in which the second division of the bone may be unnecessary.

The arteries are next to be secured, the wound freed from any coagula of blood, the flap laid down upon the side of the face, and united by two or three points of suture to the opposite side of the wound.

Indebted to the kindness of Dr. Cusack, I witnessed one of his most formidable cases, which was operated on according to the principles now laid down, and I was much gratified with the ease and readiness afforded by them to the operator, in disarticulating the jaw.

By attending to the instructions already indicated, the young surgeon will be always prepared to plan his operation, and obviate whatever impediments that present themselves, neither will he find it necessary to take up the external carotid artery, as a preparatory measure.

Observation. No surgeon ought ever to attempt this operation, where much of the bone is to be removed, without having active and cool assistants ; also the actual cautery in readiness ; that he may be prepared, without delay, to arrest the haemorrhage which is often excessive, in consequence of the numerous blood-vessels that traverse the parts through which his knife must penetrate, and which can only be restrained, by the application of such a severe agent as the actual cautery ; without these he will incur great risk of the patient dying under his hands.

Suffocation is often threatened, where much of the jaw is removed, in consequence of the attachments of those muscles which protrude, the tongue having been

cut away, their antagonising powers are of course destroyed; while the muscles which draw it backwards, will then be at perfect liberty to bring the tongue into the pharynx, and prevent the ingress of air into the trachea; also, large coagula of blood may block up the entrance into this tube; those accidents, if not promptly met, will destroy the patient. A case of this operation, performed by Professor Lallemand,* of Montpelier, strikingly exemplifies the embarrassments resulting from suffocation. The patient, after the removal of the diseased mass, (which was of considerable extent,) fell senseless on the floor; the assistants and pupils ran in dismay out of the theatre, the greatest consternation prevailed, and the wound spouting blood; the Professor, with great presence of mind, saw from whence the distress proceeded, and without loss of time, applied a cautery at a white heat, to the surface of the wound, and arrested the hæmorrhage, conscious, that whatever blood was lost could not be restored; he then plunged a bistoury between the thyroid and cricoid cartilages, when the air rushed into the trachea, and the patient seemed to awake from a deep sleep: he ultimately recovered. Great praise is due to M. Lallemand, for the coolness he displayed on such a trying occasion; and such an accident shews the

* Archives Generales, 1822.

The reader is also referred to the Med. Op. par Sabatier, tom. iv. for M. Dupuytren's cases of this operation; to the Edin. Med. and Surg. Journal, vol. xxx., p. 286, for Mr. Syme's case; to the same Journal, p. 55, for Mr. Liston's, in which he will find an interesting account of the consequences succeeding to the lesion of the portio dura; and to Johnson's Med. Chirurg. Review, vol. i. p. 210, for January, 1825, for Dr. McClelland's case. Dr. Mott has also removed a large portion of the jaw.

propriety of having the actual cautery in readiness, before commencing the operation.

Anatomy of the inferior Maxilla. The inferior maxilla consists of one bone in the adult, of a parabolic form ; it can be divided into the body, and rami, which terminate in two processes, the posterior one constituting the condyle, and the anterior the coronoid ; both have muscles attached to them ; the condyle is also fixed in its situation by ligaments : we shall consider the anatomy of these parts separately, and their connexions.

The body of the maxilla is defined, by means of the mental foramina, through which pass out the terminating branches of the inferior dental nerve, and artery : some extend this boundary to the insertion of the masseter muscles, which will be more suitable to our purpose ; this portion of the bone is covered from the attachment of these muscles to the symphysis menti, by the common integuments, a part of the insertion of the platysma myoides, the origin of the depressor anguli oris, also of the depressor labii inferioris, while at the most posterior part of this region, we observe, ascending immediately anterior to the masseter, the facial or external maxillary artery, also the vein of the same name ; when the internal surface of this part of the bone is examined, the following muscles are seen to be attached to it, also the mucous membrane of the mouth, to the genii processes, the genio-hyoideus, and the genio-hyo-glossus ; to the oblique ridge that slants upwards and backwards, is the mylo-hyoideus, and on each side of the genii processes, is a depression, in which the anterior extremities of the sub-lingual glands are lodged ; whilst in the fossa, at the inferior edge or base of the jaw, near the symphysis, is inserted the anterior belly of the digastricus ; we also find,

connected to the base, a portion of the cervical fascia, and running parallel to it, but a little under the protection of the bone, is the submental artery; in which situation the submaxillary gland is also placed.

If the disease invades but the limits of this division of the bone, no important vessels or nerves can be wounded; the only ones that are endangered, being the submental, and arteries derived from the lingual, which are of no great consequence; portions of the sublingual, and submaxillary glands, may be injured: hence it follows, that this part of the jaw can be removed without any serious lesion to the system, and with but little difficulty to the operator.

The rami deserve more attention, since they are placed in the vicinity of some large arteries, and nerves, from which they should be dissected with the greatest care, so as not to wound them; on the external surface, these processes are covered by the common integuments, and a process sent from the cervical fascia, which is ultimately connected with that of the temporal muscle; underneath this membrane, is a portion of the parotid gland, and Steno's duct, which crosses the masseter muscle, to open into the mouth, opposite the second last molar tooth of the upper jaw; it is accompanied by the transversalis faciei artery, and that slip of the parotid g. which is named the socia parotidis, both lie between the duct and the zygoma; the gland is penetrated by the portio dura nerve. Subjacent to these parts, is the masseter, in close apposition with the external surface of the ramus, to the posterior edge of which that part of the cervical fascia named the stylo maxillary ligament, is inserted, and partly separates the masseter from the internal pterygoideus, which is attached to the internal surface of the ra-

mus. Between the internal pterygoid and ramus of the jaw, the following parts will be seen to take their course, to be distributed to deep seated organs, viz. the inferior dental nerve, and artery, also the gustatory nerve; and the internal lateral ligament; the condyle is buried in the inter-articular cartilage, and has inserted into it a part of the pterygoideus externus, whilst the neck of the bone protects the course of the internal maxillary artery, which is almost in juxta-position with it; and the temporal muscle is attached to the coronoid process of the lower jaw. The student will be attentive to observe the relations of the external carotid artery, which he will find to run nearly parallel to the posterior edge of the ramus, and through the parotid gland.

The reader has already remarked the greater importance of the relations of this portion of the maxilla, when compared to that which constitutes the body; now let him consider, the number of blood vessels, as the external carotid, and the course of the internal maxillary, connected with it, both of which will be opened if the operator makes an incautious use of his knife, when the condyle is being extirpated; but neither of them ought to be injured, if due attention is paid to the operation. Some of the nerves in this situation must be sacrificed; such are the portio dura, the inferior dental, and the twigs derived from it; also those supplying the masseter and buccinator muscles: the minor arteries, as the massetic, buccal, and inferior dental, I purposely omit, as they cannot be avoided, when the ramus is being extirpated; the gustatory nerve will also incur imminent danger, at the time the operator is detaching the int. pterygoideus from this part of the bone, but, by cutting close upon it, the nerve will be always protected.

CHAPTER V.

AMPUTATION OF THE INFERIOR EXTREMITIES.

AMPUTATIONS *on the Foot.* Removal of the second, third, or fourth toes, from the metatarso-phalangar Articulation. Though the partial amputation of a toe is alone required, still it is preferable to operate in the joint above-named, since the stump that remains, will be more convenient to the patient, than if the amputation was partial: this operation is performed on the same principle as that in the hand, namely, to ascertain the precise situation of the articulation, and make a flap incision on each side of the toe, which exposes the cavity, when the ligaments are to be divided, and the toe removed.

Observation. It will be necessary to recollect that the joints are placed at a considerable distance behind the cuticular folds that are situated in their interstices, which renders it necessary when cutting into the sole of the foot, to carry the incisions to such a depth as will satisfy the operator that he will freely open the articulation. If possible, the heads of the metatarsal bones should be

preserved, and the phalanges alone removed ; in this respect the operation differs widely from similar operations on the hand ; for if they are removed, the foot will become contracted, and the base afforded by it so injured, as to offer but a poor and narrow support for the limb.

Amputation of the great Toe in the metatarso-phalangar Articulation. First plan. The patient's foot being well supported upon a low chair, the operator sitting in front, ascertains the situation of the joint, and commences the incision, about half an inch posterior to it, which he continues along the dorsum of the toe to its external side ; he then carries the incision between the great toe, and that next to it, passing underneath the former to its internal side, so as to terminate at the place where it first began. He then dissects back the flaps, exposes the ligaments, and divides them ; opening by this means into the joint, removes the toe, and secures the vessels. When the lips of the wound are united, the line of junction assumes the horizontal direction.

Second plan. The patient seated as in the first operation, the toe may be removed, by a horizontal incision, carried from about half an inch posterior to the joint, and on the internal side, to the centre of the first phalanx ; where it terminates, a circular incision is next to pass round the bone, by which means two flaps are obtained, which are to be dissected back, when

the operator will be able to open the articulation, and finish the operation.

Observation. This method alone differs from the first, in affording two angular flaps; while the other forms two with slightly convex edges; at the time the integuments are being divided, and the knife passes over the joint, the operator will do well to press upon it, which will insure the articulation being opened, consequently no delay will arise, when he searches for the articular cavity.

Amputation of the little Toe, in the metatarso-phalangar Articulation. Either of the preceding operations will answer for this purpose.

Amputation of all the Toes, in their metatarso-phalangar Articulations. This operation is performed in the same manner, as that for the fingers, with this exception, that in the latter the thumb is preserved, while in the former all the toes, including even the great one, are to be removed.

Amputation of the first metatarsal Bone in its continuity. Three plans have been devised for this operation.

First one. Having placed the foot securely upon a low, firm chair, the integuments and soft parts at the internal side of the bone, are to be laid hold of, and drawn inwards as much as possible, from which the flap is to be made; when the surgeon will plunge a straight scalpel perpendicular to the bone between it and these parts, at a proper distance behind the portion

which is intended to be amputated, and carry it a little beyond the metatarso-phalangar articulation, close to the bone, in this manner, forming the flap, which is to be retracted; he will next pass the scalpel between the first and second metatarsal bones, till it appears in the sole of the foot, without injury to the skin, either on the dorsal or plantar surfaces, (this is readily managed by drawing the integuments outwards, and conducting the knife, obliquely downwards, and inwards, at the same time keeping it close to the bone which is the subject of the operation,) and cut forwards till the bones are separated from each other; a card or piece of tin being introduced between them, to protect the soft parts; he will saw the bone obliquely from behind forwards and outwards. Any vessel requiring the ligature, is to be secured, before the stump is dressed.

Second plan. The first incision should begin at the centre and internal surface of the bone, immediately behind the part to be amputated, and with a gentle sweep be carried forwards, along the internal and inferior part of the foot, till it arrives between the great toe and the one next to it; the second incision, parting from the same point as the first, is to pass with a gentle curve over the dorsum of the foot, till it meets with the one that has already been made; after which the bone ought to be separated from the surrounding soft parts, and sawed in the way already directed, the arteries may be then secured.

This method gives us two flaps, one dorsal and one plantar, with the line of union running in the horizontal direction.

Third plan. Let an assistant retract the skin towards the instep, while the surgeon separates the great toe from the others, and passes a scalpel between the two metatarsal bones, to the necessary distance, observing that it advances equally on the dorsum and sole of the foot; the terminations of this incision he unites by a half circular one, dividing all the soft parts to the bone; having retracted them, it is to be sawed, in the manner already described, and the vessels secured.

Observation. The third manner of operating allows but a poor flap, which is partly obtained from the integuments, on the dorsum and sole of the foot; still, as they are very lax, they can be made, by some management, to afford a useful covering for the bone. The second method, will be found of very quick performance, and will make a very good full covering for the stump.

Amputation of the fifth metatarsal Bone, in its continuity. The same operations may be advantageously adapted for it, as for the preceding bone; gunshot wounds, carious affections, and comminuted fractures, are the most frequent causes that require the removal of portions of these bones.

Extirpation of the metatarsal Bone, sustaining the great Toe at the tarsal Joint. The foot having been properly secured, and the situation of the articulation between the metatarsal and internal

cuneiform bones found, which may be hit off with the greatest certainty, by marking the course of the tendon, of the tibialis anticus m. as it descends to be attached to the internal and inferior surface of the internal cuneiform bone, an inch anterior to the tendon, the joint will be met.

The first incision will commence a little behind the articulation, at the internal side of the foot, from whence it is to be carried forwards, with a gentle curve, crossing the dorsum of the foot, till it arrives between the phalanges of the great toe and the one next to it; the second, will also begin from the same point as the first, and pass along the edge of the sole of the foot, to terminate between the phalanges already mentioned, where it unites with the other incision. Having removed from the subjacent parts, the tegumentary coverings, the joint can be entered, which is facilitated by depressing the metatarsal bone, and in this way dislocating it; nothing then remains to be done, but to cut the insertion of the peroneus longus muscle, which is implanted into the base of the metatarsal bone, and offers the only impediment to its removal; when the vessels must be secured, and the flaps brought together to procure union. In many cases, by a careful dissection, the flap may be principally gained from the sole of the foot. When cases will admit, it is preferable to perform partial amputation of this bone, than to remove it *in toto*, as it will preserve, for the patient, the uses of the peroneus longus m., the tendon not being cut away.

Extirpation of the fifth metatarsal Bone, at the tarsal Articulation. First plan. Having separated the little toe from the one next to it, a scalpel may be passed between them, dividing equally the parts on the dorsum and sole of the foot, till it is arrested by the os cuboides; the knife is then turned a little outwards, at the same time that the metatarsal bone is abducted, and the joint opened from within outwards; the external ligament being cut, the knife is to be brought forward, on the outer side of the bone, to form the flap, from the parts which lie on this aspect of it.

Second plan. When the base of the metatarsal bone is examined, its tubercle will be found, which indicates the point at which the incision is to begin; the soft parts are to be seized and drawn outwards, when the operator will pass a straight scalpel through them, from above downwards close to the bone, till it has penetrated the sole of the foot, and bring it forward along the metatarsal bone, so as to make the flap of sufficient size; after it is reflected, he will cut through the external lateral ligament of the tarso-metatarsal articulation, the attachment of the peroneus brevis, and internal lateral ligament; the surgeon will then insinuate the knife between the fourth and fifth metatarsal bones, in such a manner as to protect the teguments both on the dorsal and plantar surfaces of the foot; and separate all connexions between these bones, when the one that is the

subject of the operation can be removed from the cuboid bone.

Third plan, consists in making an incision, that extends from the tubercle of the bone to the phalanx of the toe, along the external side, when the soft parts that are situated on its dorsal and plantar aspect are to be dissected from it; the metatarsal bone is next freed from its connexions with the tarso-metatarsal articulations, and extirpated, and the arteries tied. The flaps when united form a line, that extends from the cuboid bone, to the phalanges of the toes.

Observation. The two first plans are nothing more than performing the same operation in a different manner, and are not preferable to the last, which will enable us to accomplish our object with little trouble, and affords a good cushion on the outside of the foot. The tubercle of the metatarsal bone, should be always preserved, whenever the disease will permit, as it will continue to the patient the action of the peroneus tertius, and brevis muscles; it also constitutes one of the principal points on which the foot rests on the external edge.

Extirpation of the second, third, and fourth, metatarsal Bones, at their tarsal Articulations. Let the surgeon mark the course of the tarso-metatarsal joints, which can be found, by drawing a line from the tubercle of the fifth metatarsal bone, across the dorsum of the foot, to the anterior edge of the tibialis anticus tendon; the incision is to commence a little behind this line, and

should be carried forward to the toes ; it may be either a single incision, or of a V shape, the apex being situated at the tarsus. In order to gain a clear view of the line of the articulations, the tegumentary coverings, and tendons placed upon the dorsum of the foot, must be dissected from it, the first everted, and the last cut across ; this step is not productive of much pain, provided the dissection is continued forwards towards the toes, as the nerves have been previously divided.

The next proceeding is to disarticulate the bones, which may be accomplished by bearing on their anterior extremities, at the same time running the knife along the external side of the fourth metatarsal bone, till it is arrested by the cuboid : having opened this articulation by turning the scalpel inwards, that of the third metatarsal bone can be entered in a similar manner ; the articulation of the second of these bones, is the most difficult to be dislocated, since it is wedged in between the first and third cuneiform bones : however, by a little patience, and passing the knife on each side of the head of the metatarsal bone, into the tarsus, it will be attained, but not without much trouble.

The disarticulation being accomplished, the bones are then to be separated from their connexions in the sole of the foot, and removed ; the plantar arteries are, if possible, not to be injured. If any nerve, tendon, or ligament, projects into

the wound, they are to be cut close to the tarsus; the arteries that require ligatures, are next to be tied, the wound filled with lint, and the foot bandaged.

Observation. The disarticulation of these three bones, is by no means a trifling operation, as they are so wedged together, and intimately connected to the tarsus, by ligaments, that a considerable time will be occupied in accomplishing it; indeed so tedious is it sometimes found, that many prefer to use the chain saw passed a little anterior to the heads of the bones, and saw through them; even this proceeding is attended with great difficulty. From repeated trials on the dead subject, I feel myself justified in recommending, as the most certain way, to extirpate them, when the scalpel is alone used, the following method, namely, to run the knife along their sides, to the tarsus, which will conduct the operator more directly into the joints, than any attempt made to enter them from their dorsal aspect.

Partial Amputation of the Foot, anterior to the tarso-metatarsal Articulation. In this, and the succeeding operations on the foot, I scarcely think it necessary, to recommend the application of the tourniquet, to guard against hæmorrhage, as the posterior tibial artery, which furnishes the plantar arteries, the principal vessels of the foot, can always be compressed behind the internal ankle, by an intelligent assistant; however, should the operator conceive it necessary to use it, it is to be applied upon the femoral artery, as it penetrates the tendon of the triceps adductor magnus m., or at the inferior third of the thigh.

The foot and leg being firmly fixed, the operator seizes the anterior part of the foot with his left hand, to support it, and commences the dorsal incision, two fingers' breadth anterior (or as much as the case will allow) to the line of the tarso-metatarsal articulation, and continues it with a gentle curve, anteriorly from the external to the internal side of the foot, for the right, and *v. v.* for the left one, penetrating all the soft parts to the bones; as this incision is nearly parallel to the articulations, it crosses the foot in an oblique course, from without inwards and forwards. On the plantar surface, the surgeon makes his second incision, having the same direction as the first, but if possible, more anterior than it, and divides the integuments, and other parts, till the metatarsus is exposed; having retracted the flaps, the bones can then be sawed upon a line corresponding to the incisions. He next secures the plantar arteries, the largest being situated at the external side of the foot; then those that lie upon the dorsum; before the flaps are united, the surgeon is careful that no nerve or tendon remains in the line of adhesion.

Observation. This operation, in many cases, may supersede that of MM. Chopart and Hey, which will be mentioned immediately, as it inflicts a much less injury on the mechanism of the foot, than either of these: it also protects the insertions of the three peroneal muscles, and does not diminish, to any considerable extent, the basis on which the inferior extremity rests; when the

flap is principally made from the sole of the foot, the stump will be better protected, than if much of the integuments of the dorsum enter into it.

*Amputation in the Foot, in the tarso-metatarsal Joints, or Mr. Hey's operation.** The great object in this operation, for its quick performance, is to mark out the line of the articulations, which may be always effected by the following rule:—as the tubercle of the fifth metatarsal bone can be always discovered in every foot, it will point out the situation of the joint on this side; if from it, a line be drawn at right angles to the axis of the foot, to its internal side, about half an inch anterior to the place at which it terminates, the articulation will be found, between the first metatarsal, and internal cuneiform bones; or if the tendon of the tibialis anticus muscle is very evident, an inch or so anterior to it, will also shew the articulation.

These two points having been ascertained, and the foot firmly supported upon a low chair, an incision of a semicircular form is to be carried from one of these points to the other, across the dorsum of the foot, the convexity looking towards the toes; an assistant having retracted the skin, the operator then continues the operation by freeing the metatarsus from its connexions with the tarsus: if it is the right

* Hey's Surgery, p. 554.

foot, he ought to begin at the external side, and divide the ligaments that attach the metatarsal bone, to the cuboid one, and then open the articulations of the two succeeding; it is then expedient for him to apply the knife to the internal side of the foot, and separate the connexions of the first metatarsal bone with its cuneiform one, recollecting that this articulation is considerably more anterior than the others, in consequence of the projection of the first cuneiform bone into the metatarsus. The knife is then to be passed fearlessly on each side of the second metatarsal bone, into the tarsus, which will alone enable the operator, to destroy with celerity, any union between it and the neighbouring bones.

All the articular attachments having been divided, the foot can be disarticulated, by bending it forcibly, which will break down any remaining union the metatarsus may have to the tarsus, except by the peroneus longus muscle, and the soft parts composing the sole. The tendon of the peroneus longus muscle, which is seen when the foot is depressed, stretching from without inwards, is to be cut close to the tarsus; the anterior part of the foot is now rendered comparatively free, and allows the surgeon to pass his knife between the metatarsus and sole of the foot, who divides it from the metatarsal bones, to form the flap, which is to be longer at the internal than external side of the foot, to allow of a covering sufficient for the internal cuneiform bone, as it pro-

jects farther than any of the others of this range, into the metatarsus; the arteries are then to be secured, and the flap applied to the tarsus, and retained by the usual means.

Observations. The preceding operation affords but one flap, which is entirely formed from the sole of the foot. Sir A. Cooper affirms there is always more favourable union, when two flaps are formed, one superior and the other inferior, which may be made in the following manner:—the dorsal one is to be procured by carrying an incision across the foot, one inch anterior to the line of this articulation; from the terminations of this incision, let two others be made, along the internal and external metatarsal bones, for two inches and an half, which are to be united by a transverse one, extending in an oblique direction, from without inwards, on the sole of the foot; the bones are to be disarticulated in the manner already mentioned. Mr. Guthrie advises a similar operation.*

Sir A. Cooper, also maintains that it is better to saw through the bones than to remove them at their articulations; for the process of union, in his opinion, is impeded by the remains of the synovial membranes still secreting the synovia.† In direct opposition to this gentleman, we find Mr. Guthrie stating, that in cases of gunshot wounds, it is more useful to amputate in the joints than to saw the bones, and the impediments to cicatrization which the former speaks of, can be easily avoided by scraping away these membranes, before closing the wound.‡ It appears

* Guthrie on Gunshot Wounds, p. 405.

† Cooper's Lect. by Tyrrell, vol. ii. p. 423.

‡ Guthrie on Gunshot Wounds, p. 405.

to me the proposal for sawing the bones is more expeditious, and may be adopted by the generality of surgeons, as being attended with the greatest ease in the performance; unless the surgeon is intimately acquainted with the direction and formation of the different joints in this situation, he will find it a much more tedious business to open them than he had anticipated, and in either case, the projecting portion of the internal cuneiform bone must be removed, by the saw, to allow of an even surface.

If the operator intends to accomplish his object by laying open the joints, and luxate the bones, he should be particularly attentive, what direction he gives his knife; when separating the external metatarsal bone from the cuboid, as their union is so very oblique from without inwards and forwards, that the most trifling deviation from it posteriorly, will carry the knife between the os cuboides and calcis, and produce considerable embarrassment and delay in the operation. To find out the articulation between the cuboid and fifth metatarsal bones, which may be considered the key to the joints on this side of the foot, it will be necessary to draw a line from behind the tubercle inwards to the middle of the metatarsal bone that supports the great toe; this line will always indicate the course the knife has to take to enter into the articulation, between the cuboid and the fifth metatarsal bone.

Amputation of the Foot, between the os calcis, and the astragulus, posteriorly, and the cuboid and navicular Bones, anteriorly—or M. CHOPART'S Operation. To perform this operation with the requisite dexterity, the articulation between these bones ought to be correctly ascertained,

which is to be effected by searching for the tubercle at the internal side of the os naviculare, into which the tibialis posticus m. is inserted: immediately behind this point, the joint between it and the os astragulus, will be found; while the one situated between the cuboides and the os calcis, will be met with about half an inch, or a little more posterior than the tubercle of the fifth metatarsal bone. The line of these articulations is directly transverse to the axis of the foot; so much having been arranged, and the limb supported on the heel, the operator makes a semi-lunar incision, from one of these points to the other, on the superior part of the foot, bearing heavily on the knife, in order to cut through every thing to the bones; as soon as the skin retracts, he proceeds to open the articulations, (if this is commenced at the external side of the foot,) cutting directly into the tarsus, half an inch behind the base of the fifth metatarsal bone, and separates the cuboid from the os calcis; if this incision is continued across the tarsus, the os naviculare and astragulus will be quickly detached from each other.

This part of the operation is much expedited by bearing on the anterior part of the foot, as it partly separates the joints from each other, which will also be more readily found, by beginning at the external than internal part of the tarsus. All connexions between the two portions of the tarsus having been cut through, the surgeon forms

the flap as in the preceding operation, by passing the knife between the soft parts and bones at their inferior aspect, until they are sufficiently divided to form a flap of such a size, as will cover the face of the stump. The internal and external planter arteries, with the dorsalis pedis, having been secured, and any over length of nerve or tendon pared away, the stump is to be dressed.

M. Chopart, the original proposer of this operation, without previously attending to the situation of the tarsal joint, made a transverse incision across the foot, about two inches anterior to the ankle; he then carried two longitudinal ones, commencing a little below and in front of each malleolus, forward, to terminate in the first incision; by means of the latter incisions, he divided some very dense cellular membrane, particularly at the external side of the foot, which otherwise prevents the retraction of the skin; they also enabled him to form the inferior flap more easily; he then retracted the soft parts, and opened into the tarsal articulation.

This operation may be so executed as to have two flaps, one dorsal and one plantar, observing to make the principal one from the latter surface, which is better able to resist injuries.

I would advise the surgeon whenever he has an opportunity of refreshing his memory as to the course of these articulations, prior to undertaking any amputation on the foot, not to neglect it, as it will decidedly facilitate the ope-

ration; by attending to the points already laid down, he cannot go astray.

Amputation of the Leg. This operation may be performed by the circular incision; also with a single or a double flap; the former is most applicable to the upper thick part of the limb, about the calf; while the latter is to be preferred, when the foot is to be removed near the ankle, where a sufficiency of integuments and soft parts cannot be procured for making a stump, unless the bone be denuded to a considerable extent. The double flap operation is entirely laid aside, even by the gentleman, Mr. Roux, who revived it, as it is not very satisfactory in its performance, nor affords any advantage that cannot be obtained from either of the other two, which are of more simple execution.

In amputation on this section of the inferior extremity, surgeons of much experience are at variance, as to what part of the limb the operation should be performed; some insist upon the necessity of performing it, as near the ankle as possible, as it inflicts a less shock upon the system, but do not take into consideration the length of stump left by it; others, on the contrary, advise the amputation to be performed within a hand's breadth of the knee joint, conceiving, the increased severity of the shock as of no moment, when the advantage is estimated, that results from a short stump, which is no inconvenience to the individual; while the long and

useless one, that remains after the operation near the ankle, is always a source of annoyance to him; indeed, in the works of many naval and military surgeons, we read of patients, who had their legs amputated close to the ankle, applying for, and cheerfully submitting to the severity of a second amputation, to get rid of such an unnecessary appendage. In the lower walks of life, which cannot afford the patient the means of obtaining a symmetrical artificial leg, it is more prudent to amputate near the knee, which leaves him in the best condition for using the common wooden leg; whilst in the higher walks, the surgeon may operate in the inferior part of the limb, and give a long stump, for the artificial foot and ankle to be appended to.

Amputation with the single flap. First plan. The experienced surgeon can avail himself indifferently of cutting from within outwards, or the contrary; or he may make the half circular cut on the anterior part of the leg, and form the flap afterwards, depending solely on the correctness of his eye for having it of a proper size; but as the inexperienced surgeon cannot, in general, rely on his judgment, in his first essays to make the flap of the exact size, I shall transcribe in full for him, the rules given by the late Mr. Hey for marking the precise places, where the different incisions ought to be made, so as to obtain a full and well made flap; and the part of the bones to which the saw is to be applied.

" To ascertain with precision the place where the bones of the leg are to be divided with the saw, together with the length and breadth of the flap, I draw upon the limb, four lines, three of them circular, and one of them longitudinal ; the situation of these lines is determined in the following manner :—I first measure the length of the leg from the knee to the ankle ; that is, from the highest part of the tibia to the middle of the inferior protuberance of the fibula ; at the midway between these two joints, I make the first or highest circular mark upon the leg. This mark is to point out the place where the bones are to be sawn through. At this mark I also measure the circumference of the leg, and thence determine the length and breadth of the flap, each of which is to be equal to one-third of the circumference. In measuring the circumference of the limb, I make use of a piece of marked tape, or riband, and place the extremity of this measure upon the anterior edge of the tibia : I will suppose the circumference to be twelve inches, in which case I make a dot, in the circular mark on each side of the leg, at the distance of four inches from the anterior edge of the tibia. It is evident that these dots will be found four inches distant from each other, when the measure is applied to the posterior part of the leg. From the dot which is on the outside of the leg I draw a straight line downwards, four inches in length, and parallel to the anterior edge of the tibia. This line marks

the course which the catlin is to take in the formation of the flap. At the extremity of this line I make a second circular mark upon the leg, which points out the place near which the flap is to terminate. Lastly, I make a third circular mark, at the distance of an inch below the superior one which was first made, which intermediate mark is designed to direct the circular incision, through the integuments on the anterior part of the limb. The course and extent of the different incisions, being thus marked out, the operation may be performed with the greatest ease.

" The catlin, which is used for the purpose of making the flap, ought to be longer than the one commonly made, (one seven inches long in the blade will answer every purpose.) I push the catlin through the leg, a little below the place where the transverse incision is to be made of those muscles which are not included in the flap. Having placed the limb in a position nearly horizontal, with the fibula upwards, and the knee bent, I push the catlin *through the leg,** and carry it downwards along the course of the longitudinal mark, till it approaches the lowest circular mark, which it joins in the course of the curved line, and the incision then terminates a little below the inferior circular line, *e c.*

" The flap being held back by an assistant, I

* Reference to the Plate is made.

divide the integuments on the anterior part of the limb, along the course of the circular mark, *b d.* There is always a considerable retraction of the skin, after it is divided, if the integuments are in a sound state; and if a proper allowance was not made for this retraction, the extremity of the tibia would be left uncovered, and the flap could not be applied with so much ease to the patient, nor with the certainty of a union by the adhesive process. The muscles which are not included in the flap, are then divided transversely, a little below where the bones are to be sawn through; but no great quantity of muscular flesh can be conveniently preserved, below the extremity of the divided bones, (on account of the adhesion of the muscles to the bones,) nor is it necessary, as the flap, when made in the middle of the leg, contains a portion of the gastrocnemius, and solæus muscles, sufficient to make a good cushion for the extremity of the bones. When the bones are sawn through, it is advisable to cut off a little of the extremity of the conjoined flat tendon of the gastrocnemius and solæus muscles, as it is apt to project beyond the skin, when the flap is placed in its proper situation."

Some obscurity attends this extract, in consequence of not having a plate; however, when the student transfers the measurements, as he finds them in the preceding lines, to the subject, any little confusion which may be present, will immediately vanish. In the other modes

of making the single flap, the operator must entirely depend on his eye, and will be mindful to have it a little too long, than too short. The following operation, as performed by M. Lisfranc, is remarkable for its great celerity and simplicity, and may be adopted for the inferior third of the limb.

Second plan. M. LISFRANC'S *Operation for the inferior third of the Leg.* The patient being seated upon a table of a convenient height, and the tourniquet applied upon the femoral artery, as it perforates the triceps adductor magnus muscle, which is the situation to be chosen for the instrument in all amputations of the leg, two assistants support the limb; one secures it at the knee joint, while the other takes charge of the foot; the operator, whether it is the right or the left leg, will find it to his advantage, to stand on that side of the limb, which allows his left hand to be next the patient's trunk, with which he grasps the leg, and places the thumb on the internal angle of the tibia, and the index finger on the fibula, for the left leg, and *v. v.* for the right; then with a catlin, he makes a semicircular incision on the anterior part of the leg, drawing the knife from heel to point, and from the index finger to the thumb, at which place he passes it into the limb, with the surfaces looking backwards and forwards, in close contact with the bones, until the point appears at the opposite angle, and cuts downwards and outwards to form the flap in

proportion to the size of the limb; he next separates the soft parts in the interosseous space, applies the retractor, and saws the bones, which the flap will easily cover.

A third plan of operating with a flap is presented to the surgeon in that of Mr. C. Bell; in which, with a large amputating knife, he makes an oblique incision upwards, through the skin at the back of the leg, after the integuments have been retracted; the knife is then applied close to their edges, which he carries obliquely upwards, through the mass of muscles in this region, till it meets the bones; from which situation he draws it in a half circle, on the anterior part of the leg, and in this manner unites the angles of the first incision; whatever lies in the interosseous space he then divides, and having applied the retractor, saws the bones. A similar operation is recommended by Mr. Guthrie.

Amputation of the Leg with two Flaps. We are indebted to Mr. Roux, for the revival of this style of amputating. The operation is performed as follows:—The position of the limb and tourniquet having been arranged, an incision of two inches in extent is to be made on the anterior part of the leg, commencing immediately below the place where the bones are to be sawed; having seized the soft parts, and drawn them inwards, a catlin is then entered into the incision that has been already made, at its superior angle, and half encircling the tibia, penetrates through

the calf, and appears at the posterior part of the leg, by which the internal flap is formed. The knife is to be again introduced into the wound at the anterior part of the leg, the soft parts having been previously drawn outwards, and will encompass the fibula, with a small part of the tibia, so as to appear in the solution of continuity on the posterior part of the limb, to form the external flap.

The remaining steps are conducted in the usual way.

M. Dupuytren has also attempted the double flap operation, as follows:—an incision three inches long, in front of the tibia, and a similar one, at its posterior side, having been made, he joins their extremities by a circular incision, which will give two flaps; after these are retracted by an assistant, he saws the bones and arranges the stump.*

This operation is introduced merely to satisfy the student if he thinks fit to practise it; he will soon perceive, that it is a tedious, and unsatisfactory mode of removing the leg; also that the parts are disposed in such a manner about the bones, as to render it impossible to procure two good flaps. The best proof that I can bring forward of the discontinuance of this operation, is, that during a long period which the writer at-

* *Medicine Operatoire, par Sabatier, tom. iv. 502.*

tended the Parisian hospitals, he never saw either of those surgeons operate in this manner.

Observations. To the unpractised surgeon it sometimes happens, that the flap is not exactly proportioned to the parts which it is intended to cover, being either too large, or too small; if the former, M. Klein, who has frequently performed this operation, advises a part of it to be cut away; if the latter, he recommends to carry the incisions upwards into the leg, in order to afford one of sufficient size; he admits this proceeding is attended with some difficulty, but still urges its necessity. I have witnessed some very expert and well practised operators, compelled to resort to such a measure, when the flap was too short; though we have such good authority as that I have just alluded to, I need not add what is evident to every person, that it is an unsightly and awkward business for a surgeon to remodel his flap.

When the flap is made, by passing the catlin between the muscles, and bones then cutting out, I would advise it to be introduced at the *external* side of the limb, and pushed from the fibula to the tibia, and never in the opposite direction; my reason for pressing this on the reader's attention, will be instantly perceived, if he will but examine the relations of these two bones, when *in situ*, which are so placed, that the fibula is on a plane posterior to the tibia, from which it will follow, if the knife is passed from within outwards, unless the greatest care is paid to its direction, it will to a certainty penetrate between the tibia and fibula, and cause the most distressing delay to the operation, while there is not a possibility of such an accident occurring, when the parts are attacked in the way recommended. Much attention is ne-

cessary when sawing the bones, not to splinter them ; to guard against such an occurrence, and to prevent their protrusion, the fibula ought always to be sawn before the tibia ; in order to effect which, the surgeon should stand at the inside of the leg, which position will permit him, either to saw both bones together, or to divide the fibula first ; on the contrary, if he stands at the external side, he must fall on one knee, to be in a proper situation to make the section of the fibula before that of the tibia, or depress his hand to such a degree as not to be able to use it, but with difficulty. Many surgeons are in the habit of sawing the fibula about a quarter or half an inch shorter than the tibia, to prevent any chance of its protrusion, and then remove the spine of the tibia, either with the saw or bone forceps. In very thin subjects, the spine ought always to be treated in this manner, or it will cause inflammation, and ulceration of the skin that covers it, and be ultimately cast off by exfoliation ; which process, always tedious, will retard the patient's recovery in a very remarkable manner.*

* The reader will find in the Medicine Operatoire, par Sabatier, a proposition of the late Professor Beclard, to remove the spine of the tibia, which consists in making two incisions, extending from the spine of the bone in an oblique direction, to its internal and external side, after the circular incision has been finished ; the skin is to be retracted and the bone sawed, in a line parallel with them, for about one-third of its depth ; after this section, the saw is to be withdrawn, and the bone sawed in such a manner, as that the second section will exactly fall where the first terminated, when the anterior angle or spine of the tibia will be removed. This proceeding causes some delay, and demands a little practice to make a perfect section, as he advises ; I see no objection to its adoption, but I apprehend the bone nippers will answer equally well to remove the projection of bone.

Amputation of the Leg in the superior part, by the circular incision. The place of selection for sawing the bones, is about a hand's breadth, or four inches, below the tuberosity of the tibia, which distance will preserve the motions of the stump.

The leg having been properly placed, and the tourniquet applied, an assistant retracts the skin, while the surgeon carries his hand, armed with the amputating knife, round the limb, (two inches below where he intends sawing the bones,) and with one sweep makes a circular incision through the skin, to the bones at the anterior and lateral parts of the leg, and to the fascia posteriorly ; it is then to be retracted for a couple of inches, by dissecting it from the subjacent structures, so intimate is the union between them ; he now applies the knife close to the retracted skin, and divides all the intervening textures, cutting them in an inclined direction upwards, till it arrives at the bones ; when he dissects the soft parts from them, for a sufficient distance, to gain a good stump. After having penetrated through whatever is situated in the interosseous space, by means of a catlin ; a three-tailed retractor is to be applied, the centre one can be easily passed between the bones, by arming it with an eyed probe. The muscles being in this manner protected, the operator saws the bones as already directed for the flap operation, and secures three vessels, the anterior and posterior ti-

bials, which are found immediately anterior and posterior to the interosseous ligament, also the fibular, which lies behind the fibula; sometimes one, or two well sized muscular arteries will be detected in the thick part of the calf; and the stump dressed.

Surgeons differ as to the direction in which the flap should form the line of union across the bones. Guthrie advises to bring the soft parts in the perpendicular direction, as it will obviate any pressure from the spine of the tibia; while Richerand* recommends the contrary line for their junction, assigning as a reason for his suggestion, that the transverse diameter of the bones is greater than the perpendicular, consequently less surface is required to be covered. As far as my experience allows me to judge, I have witnessed an equally successful result from either of those methods.

Amputation immediately below the tuberosity of the tibia, with extirpation of the head of the fibula. The profession is indebted principally to the Baron Larrey† for introducing this operation to their notice; who contends that the dread of danger arising from the extension of disease into the knee joint, or of the remaining part of the tibia becoming carious, is futile. The tuber tibiae defines the point, above which the bone

* Nosographie Chirurg. tom. iv. p. 510.

† Mem. de Chirurg. Militaire, tom. iii. pp. 386, 394.

ought never to be sawed ; if, at any distance above it, the saw is to be applied, the ligamentum patellæ will be divided, the bursa mucosa in this place laid open, the ligaments of the joint more or less injured, and the evil consequences will be, retraction of the patella, effusion of synovia, and often such disease of the articulation, as will be sufficient, to render the sanative processes very tedious ; or such derangement may occur as to demand a second amputation, as the only chance of preserving the life of the patient ; while by sawing the bone on a level with the tuberosity of the tibia, the attachment of the ligamentum patellæ will be protected, as well as the insertion of some of the flexor tendons, which are required for the motions of the stump.

The operation is to be commenced as low down as the nature of the disease will admit, by a circular incision, through the integuments, when they are dissected and retracted from the subjacent parts, as high as the tuberosity of the tibia ; the muscles are next to be cut through to the bones, which are to be cleared from them, and the saw applied immediately below this process. In order that the remaining portion of the fibula may be extirpated, a strong scalpel is to be passed upwards, along its inner side, till it enters the articulation between the two bones of the leg, and the muscular and fibrous attachments cut away, to allow of its removal ;

or what is more expeditious, let an incision be made through the skin upon the fibula, when it can be dissected from the surrounding parts with ease.

The last step of this operation, namely, the extirpation of the head of the fibula, appears to me, not so necessary to the success of it, as M. Larrey conceives; the attempt may sometimes be productive of mischief, in others it will be attended with some difficulty. As in many instances we observe a free communication to exist between the synovial cavity of the articulation of the head of the fibula and tibia, and that of the knee joint, in which case, the cavity of the latter articulation will be laid open, giving rise to inflammation of the synovial membrane, and its consequent train of dangerous symptoms; delay will sometimes attend the removal of the bone, when it is united by osseous matter to the tibia, which is not unfrequently found to exist, and will demand either great violence to bring it away, or the use of the saw; should either of these occur, disgrace will be brought on an operation, otherwise of great importance to the resources of the surgeon. It appears to me the extirpation of the head of the fibula is really detrimental to the patient, as it will injure to no small degree the uses of the biceps flexor cruris, which is inserted into this bone.

The anterior, and posterior tibial arteries, also the fibular, being secured, the stump is to be

dressed: to facilitate the approximation of the soft parts, and to prevent the spine of the tibia pressing upon them, so as to prevent ulceration, M. Larrey recommends an incision through the skin, in front of the spine, of two inches in length.

The patient, after this operation, is often able to avail himself of an artificial leg, as the breadth of the stump scarcely exceeds the extent of the calf of the artificial one.

Amputation of the Leg in the Knee Joint. The following account of this operation is extracted from *The London Medical and Physical Journal*, for July, 1826, page 90:—"Mark two points, one at the outside, and the other at the inside, of the knee, each half an inch below the tibia; draw a semicircular line from one to the other, passing a little below the insertion of the ligamentum patellæ, into the tuberosity of the tibia; draw a similar one on the posterior part of the limb. These lines limit two flaps, one anterior containing the skin, patella and its ligament; the other posterior, including the heads of the gastrocnemii muscles, the flexor tendons, and popliteal vessels." The operation was commenced by making the anterior flap, which exposed the cavity of the joint, the lateral ligaments were then divided, and with a few touches of the knife the crucial ones cut through; the posterior one was then formed and reflected, to allow the vessels being secured.

Observation. The case calling for this operation, was one, in which the bones of the leg, and soft parts, were extensively diseased, and the condyles of the femur healthy; the patient recovered after it. For a more detailed account, see the number of the periodical above quoted. This operation is but a revival of one, that was performed frequently by Fab. Hildanus, so far back as the 16th century; also by Hoin, of Dijon, and by J. L. Petit; and for nearly similar affections as the one described in the text. It is now discarded by the best practitioners.

Amputation of the Thigh. This operation may be performed at any part of the limb, from above the condyles, as high as the lesser trochanter, either by the flap, or circular incision; in general, it will be found preferable to adopt the flap operation, at the tuberosity of the bone, more particularly, in large limbs, since it will afford a better prospect for obtaining a good stump, than could be procured by the circular operation.

In the leg, as in most instances, it is advisable to leave the stump short, for the benefit of the patient; so in the thigh, it is better for every class of patients to have the stump as long as possible, which is stronger and more useful for the individual, than a short one; and less injury is inflicted upon the constitution by amputating low down, or as near the knee as possible, than in any other part of the limb. We shall first describe the manner of operating so as to form two flaps, which may be lateral, or anterior and pos-

terior; and then enter fully into the details of the circular amputation.

Amputation in the inferior third of the Thigh, with two lateral flaps. The patient having been placed upon a table of convenient height, which is covered with a blanket, folded three or four times, and the circulation commanded, either by the tourniquet applied round the limb, as high as it can be—or, what is of more avail to restrain the bleeding, an assistant compresses the femoral artery, as it passes over the brim of the pelvis, who stands on the side opposite to the surgeon; another assistant supports the diseased limb, while the surgeon standing on the outside of it, seizes the thigh with his left hand, and marks the place where the knife is to enter with the thumb; having retracted the skin, he plunges the catlin through the anterior part of the limb, till it is arrested by the bone, he then turns the point a little towards the internal side, to obviate this impediment, the pressure being still continued on the knife, till it appears at the posterior part of the thigh, when the flap on this side is formed by cutting downwards for a sufficient extent. The external flap is made after a similar fashion; the surgeon then proceeds to retract both flaps, and divides whatever soft parts are adherent to the femur, applies the retractor, and saws the bone. He next proceeds to secure the vessels, the femoral he finds in the internal flap, close to the bone; also in this flap are some

branches from the perforating arteries; the external one, besides perforating branches, contains a few large vessels, derived from the external circumflex artery. The flaps are then dressed in the usual manner.

Amputation with an anterior and a posterior flap. In some cases this plan must be adopted; for example, when the leg is so much flexed on the thigh, as will not permit the knife passing perpendicularly through the limb, without wounding the back of the leg; this position also precludes the circular operation, for obvious reasons. The surgeon seizes the soft parts on the anterior part of the thigh, and raises them from the bone, to pass the catlin from without inwards, coursing round the femur, and cuts downwards and outwards, in proportion to the size of the limb, to form the anterior flap; the posterior one he makes in a similar manner; both being reflected, he completes the operation, as in the preceding amputation.

Observation. Removing the limb in this way is very expeditious, and in many cases affords a good stump, but is attended with the disadvantage common to all flap amputations, namely, that the arteries are cut obliquely, which renders it more difficult to secure them, and prevent secondary haemorrhage; hence to guard against this very unpleasant occurrence, in every case of flap amputation, the surgeon *should always draw out the vessels from their situations*, to be positive that he can tie them at *at a proper distance above their oblique sec-*

tion ; it has always appeared to me, that more ligatures were used in the flap, than the circular operation.

In the lateral flap operation, it is recommended by every surgeon to form the internal flap the first; in consequence of which, the parts at the external side of the limb, are somewhat relaxed, as the integrity of the fascia lata has been destroyed, and the flap at this side is more readily made : this instruction, in an anatomical point of view, is strictly correct; however, if the artery is not well compressed, or the patient is unable to sustain any, even a trifling loss of blood, it is better to reverse the order in which the flaps are made, and form the external one the first, which will permit the surgeon to divide the parts containing the large vessels the last, and secure them as soon as they are cut, when scarcely an ounce of blood will be lost.

If it is the operation, consisting of anterior and posterior flaps ; by the following manœuvre the femoral artery may be divided perpendicular to its course : before commencing the operation, if the surgeon marks well the situation of the vessel, and allows a small tongue at the internal angle of the flaps to remain untouched, when they are completed, he can then cut through it, and if necessary, tie the artery before it is divided.

In a full-sized thigh, this operation ought not to be performed, since the posterior flap will be so large and heavy, that it cannot be retained *in situ* without difficulty, and a protrusion of the bone will in all probability be the consequence. For the flap operation, Mr. Guthrie recommends cutting from without inwards, and divides it into four steps, (*i. e.* the division of the soft parts,) first marking out the line of the internal one through

the skin, next the external one, then at the place where the integuments have retracted, he cuts through the muscles at the internal side of the limb, and secures the vessels ; lastly, the muscles at the external side of the member are divided ; the flaps are then reflected, and the bone sawed, he always makes the internal, a little larger than the external flap. This method will be more particularly described in the operation, below the lesser trochanter.

Amputation of the Thigh, by the circular incision. The manner of performing this operation may be classed under two heads, namely, effecting it by three incisions, or by two.

To the French surgeon Louis, are we indebted for a considerable improvement in this operation ; as, prior to his time, there was almost invariably a protrusion of the bone, and a conical shaped stump, which he was the first to perceive proceeded from the unequal retraction of the muscles ; to obviate this very serious occurrence, he saw that it was necessary to divide the muscles in such a manner, as would favour, as much as possible, their equable retraction, and operated in the following way :—Having placed a bandage round the limb, and made the first incision through the skin and superficial muscles, it was removed, to allow them to retract ; a retractor was then applied to their cut surfaces, the next incision passed through the remaining muscles and periosteum.

By this means Louis gained a great advan-

tage over his predecessors : the benefits to be derived for pursuing this plan, were so apparent, that it was soon adopted by all his contemporaries ; and still continues to be followed ; for however varied the innovations of surgeons may be, as to the manner, they divide the muscles, whether by one, two, or three, separate incisions, it will be perceived, that the principle of the French surgeon is still kept in view.

The next attempt to improve this operation, to which it is necessary to call the student's attention, is that of Mr. Alanson, who describes his method as follows :—the integuments having been made very tense, by two assistants, the one drawing them upwards, and the other downwards, the first incision passed merely through the skin, which is to be dissected from the subjacent parts, for a sufficient extent, to allow the muscles and the whole of the stump to be covered by it ; he then applied the edge of the knife under the edge of the supported integuments, upon the inner edge of the vastus internum m., and cut obliquely through that and the adjacent muscles upwards, as to the limb, and downwards as to the bone, so as to lay it bare about three or four fingers' breadth higher than is usually done, by the common perpendicular incision ; the knife was next drawn towards the operator, and keeping the edge in the same oblique line already pointed out by the former incision, the rest of the muscles are to be divided

in that direction, all round the limb, the point of the knife being in contact with, and revolving round the bone, through the whole of this division.* By this means, Mr. Alanson intended the section of the limb to present a cone, the apex being at the femur, and to be completely buried in the soft parts.

It is now acknowledged by every surgeon, the impossibility of forming a concave-faced stump, by this proceeding; indeed, if attempted, the result shows that the knife divides the soft parts spirally, and forms any thing but the kind of stump anticipated by the proposer.

The real and great improvement derived from Mr. Alanson's instructions, is impressing the necessity of union by the first intention; also, by adopting his principle, surgeons have been induced, in the double and triple incisions, to divide the muscles obliquely, upwards, to the bone, by which the section of the thigh is best made, and what he intended more effectually obtained.

M. Dupuytren has revived one of the most ancient modes of performing this operation, namely, to divide the skin and muscles to the bone at one incision, those parts having been previously powerfully retracted; then, favouring the retraction of the muscles, the knife is again applied to those which adhere to the bone, when

* Alanson on Amputation, p. 10, *et seq.*

they are divided on a line with the place where the saw is to be applied. The muscles and skin when drawn over the bone to form the stump, represent a cone, the apex of which is at the femur: the Parisian professor speaks in the highest terms of this operation, for the celerity with which it can be performed, and requiring but two incisions; much as he advocates this plan, the ordinary methods will be found to form better stumps. WITH A CUT.

The Circular Operation, as generally practised by British Surgeons. The patient being properly situated upon a table, and the tourniquet applied, or not; if it is not used, the assistant who compresses the artery, as it passes over the pelvis, should stand at the side opposite to the diseased limb, which allows him to compress the vessel in the most favourable manner; it will also prevent his interfering with the operator; who, kneeling on one knee, at the outside of the limb, passes his hand, armed with a large amputating knife, under the thigh, to its external side; or he need not take the knife till his hand is in the situation just mentioned; he next seizes the point of it with the thumb and index finger of the left hand, and commences the incision, with the heel of the knife, and with a quick and steady motion, carries it round the thigh, dividing the skin and cellular membrane, rising from his knee as they are encircled by the knife.

MM. Guthrie, Hennen, and Hutchinson, ad-

vise that this incision should also go through the fascia lata of the thigh, which should always be done.

When making the incision, the knife ought to be held firmly, by which the surgeon is aware of the force applied; it also indicates the depth of the parts divided, and makes the incisions more defined and regular: by beginning with the heel of the knife, it allows the operator to finish the last part of the incision, with the portion of the instrument towards the point, when the bending of the wrist would scarcely permit this to be accomplished; as the division of the skin is the most painful part of the operation, it ought never to be made by two incisions, when the largest thigh can be surrounded by one.

If the fascia is not completely divided by the first incision, whatever adhesions it may have by processes sent between the muscles, and particularly the attachment to the linea aspera, on the external side of the thigh, are to be cut away in order to permit of the free retraction of the integuments. The knife is now applied close to the retracted parts, the edge being inclined obliquely upwards, when the surgeon divides the superficial or first layer of muscles, consisting of the rectus femoris, sartorius, gracilis, and the hamstring muscles; the assistant who has charge of the thigh, by continuing his retraction, aids that of the divided muscles. The operator next commences the second incision through the muscles,

which constitute the deep or second layer, and with a rapid and steady sweep of the knife penetrates through them obliquely upwards, to the bone. If these three sections, are made with the requisite care, the femur will be so far denuded, as that scarcely any dissection will be necessary for the purpose of obtaining a full cushion for the bone ; so that Mr. Guthrie's injunction will be scarcely justified, of dissecting the soft parts from it, for three or four inches. All that the operator should do, is to detach them from the linea aspera, posteriorly, for a short distance, when, with the assistance of the retractor, they can be drawn considerably above that part of the bone actually laid bare by the incisions.

By acting in this manner, time is saved, and some suffering to the patient ; the surgeon may also rest satisfied that the bone will be fairly imbedded in the muscles when sawed.

The arteries next require his attention, the largest of which will be instantly recognised by its open mouth ; if any embarrassment should occur when searching for the femoral artery, by recollecting the situation of it, at the different thirds of the limb, no delay can take place : in the upper third, it lies towards the anterior and inner side of the thigh, almost subcutaneous ; in the middle one, on the internal side of the limb, and is situated about midway between the integuments and the bone ; whilst in the inferior third, the femoral artery runs next to the bone, to arrive at its posterior aspect.

Generally, from three to six ligatures will be sufficient for the bleeding vessels.*

Observation. As has been already mentioned, the integuments and fascia lata are to be divided at the same time, which allows both to be retracted together, and prevents the painful dissections of those membranes from each other, which is always done in the manner adopted by surgeons, when they divide them by separate incisions. When this injunction is not observed, and the skin is dissected from the fascia to be retracted, not only great pain, and some delay are produced, but the former is also seen to present a lifeless, pallid, appearance, consequently is not in the best condition to assume the adhesive process. If those membranes are examined in relation to each other, and to the subjacent parts, in an anatomical point of view, the necessity of adopting this advice will be still more apparent, since they are intimately united to each other; whilst on the contrary, the fascia lata, with the exception of its attachment to the linea aspera, and a few septa, which it sends in between the muscles, is only connected to the subjacent parts by

* Should any unusual hæmorrhage come from the veins, both Guthrie and Hennen recommend applying fine ligatures to them. The last writer remarks, where the great veins bleed I have never hesitated in tying them also in debilitated subjects. I have met with only one case of venous hæmorrhage to be fairly traced to contraction of the integuments, as observed by Mr. Hey, in his chapter on amputation; nor did it require an incision of the integuments as practised by him, but was relieved by loosening the bandages, and moistening the dressings with cold water.—Hennen's Mil. Surg. 3rd edition, p. 268.

very lax cellular membrane ; from whence it follows, if those adhesions are divided, which is productive of no pain, the skin and fascia may be drawn up along the muscles, as a stocking on the leg, without in any manner injuring the vitality of the former, as the vessels supplying it are not divided. If what has been said is not sufficient to abolish the usual method of operating, I request the student will put it to the test of experiment, which will convince him of the great advantage to be derived from dividing the skin and fascia lata, by the same incision, and retracting both these membranes, united to each other.

The young operator should make it a general rule, to saw more of the bone in any amputation upon an extremity, in proportion to its size, so as to have a *very full* stump, in those in whom the osseous system has not been finally developed ; than in those, in whom this process has been completed. In the former, if this precept is not considered worth attention, and the amputation is performed in the ordinary way ; if the individual arrives at maturity, the surgeon will then have cause to regret it, as his patient will have a decidedly conical stump, owing to the protrusion of the bone by the ossific process, which continues at its superior extremity, notwithstanding the operation. This phenomenon will not occur in the latter description of patient, as the increase of the bone in length, has been completed prior to the amputation.

My attention was directed to this sequela of amputation some years since, from observing a number of young people, of both sexes, in an institution in this city, who all presented extremely conical stumps ; the gentleman

who had performed most of the amputations, stated that for a year or more after the operations, the stumps preserved the full cushion which had been given to them, when they then, began to assume the opposite form; he made no attempt to explain this change in the shape: which appears to me can be only accounted for, in the manner now described.

Amputation below the lesser Trochanter. In most instances the double flap operation, is preferable to the circular one, in this situation, as it will allow a longer stump to be made, and is the only one that can be adopted, when the integuments are not in a sound state.

The manner laid down by Mr. Guthrie, for this operation, is so satisfactory, that I avail myself of it for the advantage of the student: a flannel or calico roller having been fastened round the waist, and the femoral artery compressed against the pubes, the surgeon stands on the inside of the left thigh, and the outside of the right, commences his incision through the integuments on the anterior part of the thigh, and carries it down with a gentle curve to the inner and upper part; he then makes the outer incision in the opposite direction, and brings it round underneath, to meet the point where the other ceased; these should cut through the fascia, and the whole should be separated from any attachment to the parts beneath, with the point of the knife, so as to admit of further retraction by the hands of the assistants. The muscles are then

to be divided down to the bone, nearly in the direction of the first incision, and the femoral artery and profunda secured. The outer and under incisions are then to be made in the same way : the whole is to be separated from the bone, and pressed upwards, by common broad pieces of linen, as retractors, assisted by the hands, whilst the bone is sawed through, which is done without difficulty, either from the out or inside, as may be most convenient to the surgeon. The vessels are now to be secured, even to the smallest that bleed ; the stump sponged with cold water, and well dried ; the flaps are to be brought together, and retained by a suture in the middle, and adhesive straps, and the ligatures brought through the wound as their course may point out ; compresses are to be laid upon the sides of the wound, and the whole supported by the bandage brought down for the purpose, but not made to press upon the face of the stump.

This operation is very similar to that for the hip joint, as devised by the same surgeon : it will be more immediately apparent, when treating of the different plans recommended for disarticulating at the ilio-femoral articulation.

Amputation at the Hip Joint. Appalling and severe as the alternative is, of parting with nearly a fourth of the frame, in the hopes of preserving life, surgeons ought not to be deterred from undertaking amputation at the hip joint, and with a justifiable probability of success ; from the fa-

vourable results which have attended this operation of late years, they are not alone performing their duty in proposing it, but should also solicit the patient to submit to it. In military surgery, this operation is principally performed in cases of extensive injury of the soft parts, at the pelvic extremity of the thigh, accompanied with fracture of the neck of the femur, and in fracture of the neck of the femur, produced by musket balls. While the surgeons in civil life, have performed it, in cases of encephaloid tumours,* in necrosis,† incurable abscesses about the joint, with fracture of the thigh,‡ abscesses conjoined with necrosis,§ extensive disease of the knee joint, and fracture of the femur.||

Without entering into the history of the operation, of which an interesting one will be found in *Guthrie on Gunshot Wounds*, or in *Sprengle's History of Medicine*, vol. vii., we shall proceed to the different plans which have been found the most desirable for this amputation; and as in

* Professer Pelikan, of Wilna, *Journ. de Graëffe*, tom. xiii, p. 510; *vel Journal des Prog. des Scienc. Med.* tom. ii. p. 232. † Professor Pelikan, *ut supra*, and Mr. Symes' *Edin. Surg. Jour.*, tom. xx. p. 19. ‡ M. Walther, of Bonn, *Johnson's Med. Chir. Rev.* vol. iii. 1828, p. 551. § M. Delpech, *Revue Medicale*, Sep. 1824; *vel Johnson's Med. Chirurg. Review*, p. 225. || Mr. Orton *Med. Chir. Trans.* vol. xiii. p. 605.

The two last cases recovered; the operation in both instances was undertaken under such inauspicious circumstances, that I would advise the young surgeon to read the details of the cases.

the operation of the shoulder joint, the anatomy of that articulation has been laid before the reader, for similar reasons, he will find the anatomy of the ilio-femoral joint also added, after the operations have been described.

Preparatory to each operation, the manner of compressing the femoral artery, and the position of the assistant, to whom that trust is confided, are so well laid down in Mr. Guthrie's amputation, that I have nothing to add to what he says upon that subject; but when the capsular ligament is being divided, it should be as close as possible to the acetabulum, as it expedites the dislocation of the femur, in a remarkable degree; on the contrary, if it is opened low down, near the junction of the neck with the shaft of the bone, the capsule grasps the head of the femur, and offers a considerable impediment to its luxation.

First plan. *LARREY'S Method.* The patient is to be placed in nearly a horizontal position, at the foot of the bed, or on a table of a suitable height; the surgeon standing on the inside of the thigh which is to be removed, while an intelligent assistant compresses the artery as it passes over the brim of the pelvis. The operation is now to be commenced, by laying bare the femoral vessels, immediately below Poupart's ligament, and secured both in the same ligature, the artery and the vein; the surgeon will observe that the ligature is to be applied on the femoral artery *above the origin of the profunda*, since the

division of this vessel, during the operation, without such a precaution, might cause a very serious hæmorrhage. The femoral artery being thus secured, and also a ligature placed above it to be tightened if necessary, a straight, sharp-pointed knife is plunged perpendicularly into the thigh, between the tendons that are attached to the little trochanter, and the base of the neck of the femur, until the point appears diametrically opposite, at the posterior part of the limb; the surgeon now cuts obliquely downwards and inwards with the knife, through all the parts which are to form the inner flap, and which ought not to be too large.

The flap thus formed, is to be raised by an assistant towards the scrotum, when the articulation is instantly brought into view: the obturator and some branches of the external pudic arteries, now require to be secured; a single stroke of the bistoury is sufficient to divide the capsular ligament, while the head of the bone is easily dislocated, by abducting the limb, which allows the ligamentum teres to be cut through with the same instrument. The external flap is next made, by introducing a small, straight knife between the brim of the acetabulum, and the great trochanter, which is to be carried downwards and outwards, nearly on a level with this tuberosity, so as to give a rounded form to the flap; the assistant who has charge of the flap, is to compress the bleeding vessels with his fingers, till they can be se-

cured, and the smallest arteries ought to be tied, in order to guard against secondary hæmorrhage, as much as possible. The flaps are then to be brought in contact, and retained by a suture, which is passed through the integuments; further, M. Larrey advises compresses steeped in red wine, to be applied to the wound.

Second plan. *LISFRANC'S Operation.* The patient is to be placed on a table of a proper height with the tuberosities of the ischia projecting a little beyond the edge, and the limb supported by an assistant, who maintains it in the extended position, if possible, between abduction and adduction.

The surgeon standing on the outside of the patient, and a little below the articulation, seizes the soft parts, with his left hand, at the external side of the hip joint, and plunges Lisfranc's knife (which is a strait, long, narrow, and double-edged blade, *vide* shoulder joint amputation), into the integuments, a little below, and external to the anterior superior spinous process of the ilium, penetrating close to the head of the femur, until the point appears a few lines below the tuber ischii, which place has been already marked by the operator's eye; while the knife is traversing this course, it is necessary to depress the handle outwards, in order that the point may pass round the great trochanter, and run along the external side of the femur, for the space of two or three inches, so as to form the external flap; as soon as

it is made, the assistants raise it, and compress the bleeding vessels with their fingers, or proceed immediately to tie them before the second is formed.

The surgeon again, with the left hand, removes the soft parts from the internal side of the limb, and enters the knife into the wound at the anterior part of the thigh, which is to pass below the head of the femur, close to the inner side of the neck, one edge looking a little upwards, and the other a little downwards, while the handle is partly inclined towards the abdomen; by pressing upon it in this position, the operator causes the point to appear in the angle of the wound, at the posterior part of the limb, without meeting with any portion of the pelvis. As soon as the knife has become visible on the back of the limb, the surgeon is to bring it perpendicular to the horizon, and run it along the femur for two inches or more, in which he will be guided by the thickness of the limb, for the purpose of forming the internal flap, which is effected by cutting obliquely outwards, observing not to hitch on the lesser trochanter.

When the division of the soft parts will allow of it, an assistant ought to introduce his fingers into the wound, that he may compress the femoral, and profunda arteries, before they are cut across; all the vessels are now to be secured, and both the flaps kept elevated.

The surgeon next divides whatever soft parts

have escaped the first incisions ; then taking the femur in his left hand, he abducts it, and cuts through the capsular ligament, to lay open the cavity of the joint, which enables him to divide the ligamentum teres ; whilst going from within outwards, he frees the thigh from the external part of the capsule, and any remaining soft parts that may unite it to the pelvis.

If the right thigh is to be removed, the left hand of the surgeon, according to M. Lisfranc's directions, is to guide the knife ; but as few surgeons are ambidexter, or possess much power over the left hand, the operator, if he wishes, may avail himself of his right hand for this purpose, by standing on the external side of the patient's trunk, and desiring his assistant to draw outwards the parts that are to enter into the composition of the external flap. By this manœuvre, he can proceed to operate, as if they were in his own charge.

Third plan. Mr. GUTHRIE's *Operation*. The patient should be situated on a low table, or on two field panniers placed together, covered with a folded blanket, to prevent the edges giving pain, and properly supported in a horizontal position. An assistant standing on the opposite side, and leaning over, should compress the artery against the brim of the pelvis, with a firm, hard compress of linen ; such as is generally used before the tourniquet ; he should be able to do it with his thumb, behind the compress, if it be found

insufficient. The surgeon standing on the inside, with a strong, pointed amputating knife of a middle size, makes his first incision through the skin, cellular membrane, and fascia, so as to mark out the flaps on each side, commencing about four fingers' breadth, and in a direct line below the anterior superior spinous process of the ileum, in a well-sized man ; and continuing it round in a slanting direction, at an almost equal distance from the tuberosity of the ischium, nearly opposite to the place the incision commenced. Bringing the knife to the outside of the thigh, he connects the point of the incision where he left off, with the place of commencement, by a gently curved line, by which means the outer incision is not in extent more than one-third of the size of the internal one. The integuments having retracted, the glutæus maximus is be cut from its insertion in the linea aspera, and the tendons of the glutæus medius and minimus, from the top of the trochanter major. The surgeon now placing the edge of the knife on the line of the retracted muscles of the first incision, cuts steadily through the whole of the others, blood vessels, &c., on the outside of the thigh. The artery and vein, or two arteries and a vein if the profunda is given off high up, are to be taken between the fingers and thumb of the left hand until the surgeon can draw each vessel out with the tenaculum, and place a ligature upon it. Whilst this is doing, the assistants

should press with their fingers on any small vessel that bleeds. The surgeon then cuts through the small muscles, running to be inserted between the trochanters, and those on the under part of the thigh, not yet divided, and with a large scalpel opens into the capsular ligament, the bone being strongly moved outwards, by which its round head puts the ligament on the stretch. Having extensively divided it on the forepart and inside, the ligamentum teres may now be readily cut through. The head of the bone is then easily dislocated, and two or three strokes of the knife separate any attachment the thigh may still have to the pelvis.

The vessels are now carefully to be secured. The capsular ligament, and as much of the ligamentous edge of the acetabulum ought to be removed as can readily be taken away. The nerves, if long, are to be cut short; the wound well sponged with cold water, and the integuments brought together in a line, from the spinous process of the ilium, to the tuberosity of the ischium. He remarks, it has been recommended to pare the cartilage from the bone; if it could be done with little delay, it is advisable; since it is both difficult, and demands time, to remove the cartilaginous incrustation of the acetabulum: he is not an advocate for it, principally on account of the delay, which he conceives, and justly, augments the shock already produced on the system by so severe an operation, and by keep-

ing such a large surface for any time exposed, the irritation will be considerably augmented. Mr. Guthrie further observes, that an opening ought to be made in the external flap, at the time of operating, immediately below the acetabulum, to allow the exit of any matter that may form; for, in his successful operation, he says, great benefit was derived from a casual aperture in this situation, caused by the posterior shot-hole.

Fourth plan. By a slight alteration in the formation of the flaps, as recommended in the last operation, the surgeon will be able to remove the thigh from the acetabulum, and divide the profunda femoris with the femoral artery, as the limb is being severed from the trunk, so that little or no blood will be discharged from them; perhaps not more than in an ordinary amputation.

The outline of the flap being made as in the preceding plan, and the external one being a little larger than in it; after this flap is formed and reflected, the capsular ligament is exposed on its outer side; the surgeon divides it, freely and extensively, with a scalpel; the head of the femur is now partially disarticulated; and by adducting the limb, and carrying it across the sound one, at the same time that it is rotated outwards, which motion turns the knee and foot upwards, the ligamentum teres is powerfully put upon the stretch, and is easily cut through with the re-

mainder of the capsular ligament, which offers little resistance to the knife, as it is very thin on this side of the joint.

After this section, the extremity falls a little from the trunk, and expedites the subsequent stages of the operation; the surgeon now lays hold of the head of the femur, and draws it from the pelvis, when he introduces a full-sized amputating knife between it and the soft parts, which are now the only means of union between the trunk and the bone, and cuts down close to it, avoiding the lesser trochanter; the limb, at this period, is changed from the adducted to the extended position; according as the operator divides the soft parts to the distance of two inches, or more, (as the thigh is full or otherwise,) below the trochanter minor, the wound opens, into which an assistant passes his fingers, and compresses both the profunda, and femoral vessels, as yet untouched; the knife is then drawn rapidly through the remaining muscles, blood vessels, and integuments, and the limb severed from the pelvis.

The vessels are then secured, and the usual dressings applied.

Fifth plan. Amputation at the hip joint, with a single lateral and internal flap.

This operation may be performed in the following manner: the patient should be placed as already mentioned, and the femoral artery having been previously secured, or commanded by

compression ; the operator passes a catlin into the soft parts at the inner side of the thigh, and penetrates between the lesser trochanter, and the neck of the femur, through the limb ; he then cuts downwards along the bone, to form one large flap, which is then drawn up to the scrotum, and whatever bleeding vessels appear in it, are to be commanded by the fingers of an assistant. In the next step, he abducts the limb, and opens the capsular ligament, then divides the ligamentum teres, and passes the knife from within outwards, round the head of the bone, on a line with the trochanter major, cutting through the parts on the external side of the thigh, and removes the limb.

After the arteries are tied, this large flap is to be placed across the face of the wound, and retained *in situ* by points of the interrupted suture, and union by the first intention attempted.

On the dead subject I have performed the single flap amputation, in the following manner : after the flap is made, and the capsular ligament opened at its internal aspect, and the ligamentum teres cut through ; I make a half-circular incision from the superior anterior angle of the base of the flap, to the posterior one, on a line with the trochanter major, and of a slightly convex form, the small muscles inserted into the root of this process I then divide, also the external portion of the capsular ligament, and remove the limb with facility,

One of the most strenuous advocates for this operation is M. Delpech; who attributes the great benefit derived from it, to the acetabulum being completely covered by the flap.*

Sixth plan. It is possible to amputate in the hip joint, by the following proceeding, and form two flaps, one anterior, and one posterior; the patient being properly situated, and the thigh extended upon the pelvis, an incision of two inches in extent, is to be made, from a little above the great trochanter, through the intervening parts, to the femur, and parallel to it; the wound being dilated by the operator, he passes a catlin obliquely from without inwards, close to the bone, on its anterior surface, till the point appears at the middle of the internal part of the thigh, and with it cuts downwards and outwards, to form the flap, which contains the femoral artery; an assistant elevates it, and by pressure upon the vessel, prevents any flow of blood.

The surgeon again introduces his catlin along the posterior edge of the first incision, and penetrates through the muscles at the back of the femur, winding the point round it, till it is visible in the internal wound, and forms the posterior flap. Both flaps being retracted, and the bleeding restrained by the pressure of the assistants' fingers, the surgeon abducts the

* M. Delpech's case in Johnson's Med. Chir. Review, 1825. p. 225. M. Orton's Case, Med. Chirurg. Transact. vol. xiii. p. 605.

limb as much as possible, and with a scalpel divides the small muscles inserted into the trochanteric fossa, opens boldly the capsular ligament, cuts through the ligamentum teres, and extirpates the limb ; he then proceeds to secure the arteries, according to their importance, places the flaps in apposition, and maintains them by the usual means.

This operation may be modified in the following manner, so as to have one large flap and a smaller one. The necessary measures, and position of the patient being arranged for the operation, the surgeon standing on the outer side of the limb, rotates it slightly outwards, and passes the catlin, from a little above and anterior to the great trochanter, obliquely inwards, winding *close to the bone*, till it protrudes at the internal side of the limb, a little posterior to its centre ; when he cuts downwards and outwards, so as to form a large anterior flap, which is to be immediately elevated, and the different bleeding vessels secured by temporary compression ; the anterior part of the capsule now appears, which the operator renders tense by depressing the limb, cuts boldly through it, opens the articulation, and divides the ligamentum teres, with the posterior part of the capsule, all nearly in the same instant of time. The limb now drops, and separates from the pelvis, which allows the surgeon to pass his knife from before backwards between the head of the femur and the acetabulum, and forms the posterior flap, which ought to be

smaller than the anterior, by cutting downwards and outwards.

After the vessels are secured, the anterior flap falls naturally into contact with the posterior one, and is easily retained in apposition.

Seventh plan. Mr. VETCH'S *Proposal.** The circular amputation of the thigh, as high as possible, is first performed ; the bone being laid bare, the soft parts are next dissected from it, for a couple of inches, from above downwards towards the knee ; this is productive of no pain, as the nerves have been previously divided ; the bone is then sawed, which becomes a lever in the hand of the operator, who cleans it from the soft parts up to the acetabulum, abducts it, and divides the capsular and round ligaments ; the remains of the femur are then free to be removed.

Such are the operations for amputating at the hip joint, and with which every surgeon ought to be acquainted, since a familiar knowledge of these different plans will alone enable him to modify his proceedings according to the nature of the case ; and attain for his patient the fairest prospect of placing him in the state best fitted for recovery.

In the second edition of Guthrie's work on gunshot wounds, we learn that this operation has been performed on twenty patients ; of these, three perfectly recovered, seven lived long enough to get the better of the first effects of the operation

and to shew, that they would in all probability have survived, had not death been caused by diseases totally independent of the operation ; the remaining ten died ; but all of them lived some hours, and several, many days, after its performance, although in most of these cases, the chance of success was but small.

Since the publication of this edition, there have been added to the records of surgery, seven* cases of this operation, three of which have been crowned with complete success, *Sir A. Cooper*, *MM. Delpech*, and *Orton* ; of the remaining four, one survived the operation nine weeks, and died of a visceral affection (*Pelikan*), a second for eight weeks, dying of disease not connected with the original affection, (*Syme*,) while the third and fourth cases lived to the eleventh and tenth days. (*Pelikan, Walther.*)

The propriety of this operation, is now so well established, that no surgeon who undertakes it, can be considered as rash, or fond of experimental surgery ; but must be respected as anxious to afford his patient the benefits derived from the well directed labours of his profession.

Observations. M. Larrey states that his plan of operating is a quick and ready one for removing the limb ; it undoubtedly is, as he represents it, an expeditious way of amputating in this joint, still it subjects the patient to two

* Though I mention seven, I am not able to refer the reader to Sir A. Cooper's case, which I believe has not been published.

distinct operations ; one for the femoral vessels, as he includes the vein in the ligature, the second the amputation of the limb. In some cases this operation is well worthy of the surgeon's adoption, *e. g.* where few assistants are at hand, and when no great reliance can be placed in them, to compress the femoral artery ; in such a dilemma he will act most prudently to commence the operation by securing the femoral artery, omitting the ligature on the vein, also the provisional ligature, or the "*ligature d'attente,*" as it is likely to be productive of more injury than service. Much credit is due to M. Larrey for the scientific manner in which he has urged the necessity of this operation. If the surgeon, in this operation, is determined to adopt his plan in all its details, he ought to recollect that the profunda fem. artery, may be given off above Poupart's ligament ; therefore, when he is about to secure the femoral artery, he will not lose sight of this irregularity ; see page 93 on this subject. This caution is not imaginary, as in one of Professor Pelikan's operations,* which was conducted purely on Larrey's principle, during the formation of the internal flap, alarming haemorrhage took place, owing to this irregularity being present, and overlooked.

The same objections can be urged against M. Lisfranc's hip joint amputation, which have been brought forward when noticing the shoulder joint operation, as proposed by the same surgeon. It consists of a series of stabs, which cannot be well directed, unless as the result of considerable practice ; even then they will frequently be uncertain ; the external flap is thin and poor ; a pecu-

* *Journal de Prog. des Sciences Med.* tom. ii. p. 232.

long knife is necessary for it, which, from its great length, cannot be handled with the same dexterity, as a shorter one; though liable to these disadvantages, it is an operation, which can be performed by a skilful person, with incredible celerity. I conceive it necessary to impress upon the student, the great attention to be paid in this operation, when he passes the knife through the soft parts on the internal side of the thigh, unless he is watchful how the point is directed, he will not find it a difficult matter, to drive it into the thyroid or obturator foramen.

M. Guthrie's operation affords a simple and an easy proceeding to disarticulate the hip joint, gives two well-sized, and fleshy flaps, to form the stump: it also possesses the great advantage of requiring no extraordinary skill for its performance, and is highly eligible for the first attempt; as the operator sees his way clearly before him, in the successive stages of the amputation.

The operation according to the fourth plan, is to a certain degree derived from the practice of Professor Walther,* but differs from it, by incising from without inwards, to form the first flap, which he made with a catlin passed through the soft parts, and then cut outwards. It is an operation worthy of attention, and not of difficult execution.

The lateral single flap amputation, is readily performed;† the operator must be careful to extend his internal incision a long way down the thigh, to form a flap of sufficient dimensions to cover the wound.‡ Mr. Vetch's proposal is, without doubt, an operation capable of

* Johnson's Med. Chir. Review, 1825, p. 551.

† Delpech Revue Medicale, Sept. 1824.

‡ Orton's Med. Chirurg. Trans. vol. xiii. p. 605.

attaining the end in view, but it partakes of two operations, when one will suffice. The sixth plan has been occasionally performed by myself, upon the dead subject, and leaves two full flaps ; or one large anterior flap, with a small one on the posterior aspect of the limb : the latter operation is quickly executed, and appears to me not unworthy of some attention. *Postscript.*

Anatomy of the Hip Joint. The ilio-femoral articulation, represents a ball and socket structure, that admits of every species of motion, such as extension, flexion, abduction, adduction, rotation, and circumduction, with the intermediate motions : but two bones enter into its composition, the head of the femur, which is connected with the shaft of the bone, by means of the neck, forming an obtuse angle, the sine of which looks inwards ; the aspect of this angle with the anterior superior spinous process of the ilium, and the tuberosity of the ischium, the student ought to be well acquainted with, as his catlin is to pass through it, when practising some of the operations. The os innominatum constitutes the second bone, and affords a deep cuplike cavity for the reception of the head of the femur.

These bones are united to each other by two ligaments, one at the external side of the joint, constituting the fibrous capsule, which is remarkable for its great strength, and is observed to be thickest and firmest at the anterior and external surfaces of the articulation, where it is strengthened by an accessory band of ligamentous fibres, that descends in a radiated manner, from the anterior inferior spinous process of the ilium, to be attached as low down anteriorly, as the trochanteric line ; it may be here observed, that it is this band which is the great check to violent extension of the femur on the pel-

vis; also by it, some conceive that luxation of the femur upwards on the dorsum of the ilium is compelled to present the phenomenon of rotation inwards.* The other is internal, and extends from the depression on the head of the femur, to the notch found at the internal side of the cotyloid cavity, and is named the ligamentum teres, or round ligament, it has also been termed the triangular; the articulation is also strengthened by a fibro-cartilage that surrounds the cotyloid cavity, and increases considerably the depth of it. All those parts are lubricated by means of a synovial membrane.

The muscles are not equally disposed around this joint, few being placed on the external side; the consequence of which is, that the flap corresponding to it, is always thin and meagre, when compared with the internal one.

At the anterior part of the joint, subjacent to the integuments, the sartorius and rectus femoris muscles are met with; also, portions of the iliacus internus and psoas magnus muscles; to the external side are the three glutæi, and tensor vaginæ femoris: on the posterior surface, the semimembranosus, semitendinosus, and the biceps flexor cruris, are observed, whilst in close apposition with the capsular membrane, are the pyramidalis, gemelli, the obturator internus, and the quadratus femoris muscles; at the internal region of the articulation, the gracilis, pectinæus, the three adductors, the obturator externus, and some portions of the iliacus internus, and psoas magnus muscles, particularly their tendons, are found; all of these muscles are more or less enveloped in a strong fascia,

* Boyer's Malad. Chirurg. tom. iv. p. 282.

(lata,) which sends some processes from its internal surface, inwards to be attached to the capsule of the joint. It will be necessary to divide those parts during the operation.

The surgeon ought to be intimately acquainted with the relative situation of the arteries, that pass in the vicinity of this articulation, which must be divided in the operation, and secured during, or immediately after it; the femoral leaves the pelvis beneath the middle of Poupart's ligament, and is the only vessel that can be commanded prior to commencing the operation; the obturator artery penetrates through the superior part of the obturator or thyroid foramen, and will be found between the muscles, that take their origin from the horizontal and descending branches of the pubes. The remaining are the ischiatic, and branches from the glutæal, which come out through the great sciatic foramen, and send many vessels into the muscles at the back of the thigh, and to those which form the nates.

The nerves require some attention on the part of the surgeon, to exclude them from the ligatures, and lips of the flaps; these are the anterior crural, which divides into many branches, external to the femoral artery, and at a little distance from it, they are distributed principally to the muscles on the outside of the thigh; from it the saphenus nerve also is derived, which accompanies the femoral artery, as it descends the limb; the sciatic is found at the back part of the member, and is immediately recognised by its magnitude; also some twigs descend to the posterior part of the thigh, derived from the glutæal nerve; whilst the obturator nerve is always seen taking the same course with the artery of that name.

CHAPTER VI.

EXCISION OF THE ARTICULATING EXTREMITIES OF SOME BONES, AND THE EXTIRPATION OF OTHERS FROM THEIR ARTICULATIONS.

OPERATIONS of this kind, have been but recently attended to, and claim particular attention from the surgeon, as they constitute valuable additions to the resources which he has at his command, and obviate in many cases the loss of the member, always caused by amputation. To render this class of operations available to both surgeon and student, a more intimate knowledge of anatomy is requisite than what is necessary for ordinary amputations; which induces me to enter into the anatomical details connected with this department of surgery with more attention, in order, that he may have as complete a view as possible of the subject, to fit him for the performance of such operations. According to the plan pursued in the previous part of this work, the anatomical details will be found to follow the description of each operation.

The first who led the way to this improve-

ment in Operative Surgery, were Mr. White, in England, and M. Thomas, in France, both nearly at the same period, without either being acquainted with the other's operation : the former removed the head of the humerus, whilst the latter, having witnessed the exfoliation of the head of the same bone, from a carious affection, became a warm advocate for operations of this kind, though I believe he never performed one himself. Both cases terminated favourably, and left the patients with useful arms. Shortly after this, we find that M. Moreau excised the elbow joint, and by the operation, preserved a very useful limb for his patient, a farmer's servant. Since that period, operations of this kind have been slowly gaining ground, and have been performed in many instances, with successful results through Europe. Among those surgeons, who have improved this department of surgery, Mr. Crampton, of this city, holds a very prominent rank.

Extirpation of the articulating ends of bones is often required in carious affections, frequently arising from a scrofulous diathesis ; in some cases of compound irreducible luxations, which cannot be reduced without having recourse to it ; or when the head of the bone has been so injured by the accident, that its reduction would be attended with sinister results. The expediency of this operation is also admitted in certain cases of gunshot wounds.* The records of surgery pre-

* Guthrie on Gunshot Wounds, p. 405.

sent us with many successful operations of this kind, as performed in the meta-carpo-phalangar articulation of the thumb, in the elbow joint, the shoulder joint, and the inferior extremity of the tibia; it has succeeded even in the knee and hip joints, and in many cases the astragalus has been removed when luxated, and the foot preserved; which lesion, a few years since, would have consigned the patient to amputation of the leg.

Removal of the phalangar head of the metacarpal bone of the Thumb. This operation is sometimes necessary, when the bone in question is luxated, and cannot be reduced. The extirpation of it is very simple, as no important parts can be wounded, and is effected as follows: the head of the bone, whether it projects into the palm of the hand, or rests upon the dorsum of the first phalanx of the thumb, is to be freely exposed by an incision made upon it, then carefully separated from the surrounding parts, with as little injury to the lateral ligaments as possible, next with a small saw, as much of the bone is to be removed, as will allow of the reduction being effected, and union by the first intention encouraged. In general, the patients recover with the use of the thumb.*

In old cases of this accident, the operation is scarcely justifiable; as the patient, after some time, acquires a considerable degree of motion over the luxated bones: I possess a specimen of this dislocation, anteriorly, which satisfactorily

* Hey's Surgery, p. 330.

proved the great degree of motion the individual enjoyed. Mr. Adams, of Jervis's Hospital, and Lecturer on Anatomy, has also a preparation of the same accident, in which the patient possessed much motive power in the luxated joint.

Anatomy of the metacarpo-phalangar Articulation. If the anatomical disposition of the joint is examined, it will shew the necessity of occasionally resorting to such a proceeding, the two bones being connected to each other by a lax and imperfect fibrous capsule, that supports the synovial membrane, and by two lateral ligaments, which arise on each side from the metacarpal bone, and run forward to be inserted into the base of the first phalanx ; it may also be observed, that their situation is more towards the anterior, than the posterior part of the articulation, consequently, they converge at the former, and diverge at the latter aspect of it. The ends of the two bones, that enter into the articulation, will be found to be of a wedge shape, their bases looking backwards, from which results the difficulty of reducing the bone.

The nature of this accident is such, that the head of the metacarpal bone, is forced through the narrow space, between the two lateral ligaments, towards the palm of the hand, whence arises the great impediment to reduction, namely, the difficulty of passing through this narrow interval, the head of the metacarpal bone, after it has once been luxated. This mechanical obstruction is augmented, by the state the flexor muscles are in after the luxation.

Extirpation of the metacarpal bone of the Thumb. The thumb being extended, and the

forearm placed between supination and pronation, an incision is to be made upon the external aspect of the metacarpal bone, from one extremity to the other, merely through the skin; the integuments being reflected on each side, and the tendons of the extensors primi and secundi internodii pollicis manūs muscles protected from injury, the operator is to continue his dissection on each side of the bone, so as to free it from the soft parts; he next divides the ligaments that connect it to the first phalanx, and draws the bone from its situation, and by continuing the dissection towards the carpus, detaches it from the muscles; he finally cuts through the tendon of the extensor ossis metacarpi, and opens the articulation between the trapezium, and the metacarpal bone, and so removes it. The wound is then to be dressed.

The operator, when about to divide the parts united to the carpal end of this bone, should keep the knife in close contact with it, and cut towards the bone, so as to avoid wounding the trunk of the radial artery, which passes by the external side of the metacarpal bone, to penetrate to the palm of the hand, and form the deep palmar arch of arteries.

The complete extirpation of the metacarpal bone, has been lately reported by M. Roux, in a case of osteo-sarcoma of enormous development, by means of an oval incision on its posterior surface; as recovery took place, the first phalanx

of the thumb was gradually approximated to the trapezium. The individual from whom it was extirpated, is a tailor; eight years have elapsed since the operation, and he has perfect command over the motions of the thumb.

A similar operation has been successfully performed by M. Blandin; more recently M. Roux has removed the phalangar half of the metacarpal bone, injured by the bite of a horse, preserving the phalanges, and uses of the thumb.*

Observation. The principal difficulty in this operation, is to avoid wounding the extensor tendons of the two phalanges, the short and long flexor tendons of the same bones, also the adductor pollicis manūs, and the abductor pollicis. By some management, the radial artery can be avoided, as the base of the bone is being removed from the trapezium.

Excision of the Elbow Joint. The patient may be seated, and the arm extended on a table, or he may be placed lying on the abdomen, as in the cases given by Moreau, with the forearm extended as much as possible, without creating pain; it is unnecessary to apply a tourniquet. The first incision is then commenced, about three inches above the external condyle, and carried down along the arm till it meets that process; a similar cutaneous one is to be made at the internal side of the limb, when the muscles on each

* Revue Medicale, 1830, January, p. 13.

side are to be divided to the bone; the course of the ulnar nerve is particularly to be attended to, when the internal incision is being made, as it runs considerable danger during this step of the operation; the certain course that this nerve presents, will always enable the surgeon to guard it from injury; when exposed, it should be drawn to the internal side of the arm, and confided to an assistant: the ends of the two lateral incisions are now to be united by a transverse one, dividing all the superincumbent parts to the bone. By these incisions a large quadrangular flap is obtained, which is to be dissected from the humerus. The operator is next to pass a spatula, at the anterior surface of the humerus, between it, the muscles, nerves, and arteries, that are situated on this aspect of the bone; which is easily accomplished, by cautiously dissecting the soft parts from the bone, to a sufficient extent, to admit the end of the spatula being introduced between them; which is then to be forced inwards, till it appears in the wound at the ulnar side of the arm, it must be so far passed through as to protect the soft parts on both sides of the humerus, from the action of the saw, which will divide the bone as it rests on the spatula. After the section of the humerus, it is to be dissected carefully from the parts attached to it, and the lateral ligaments cut through, that it may be removed. If no other parts are diseased but the condyles of the humerus, the ope-

ration is finished, and the flap is then to be retained, *in situ*, by a few points of suture. But, on further examination, should portions of the ulna and radius be found to be diseased, we are directed by M. Moreau to extend the incisions on each side of the forearm, so as to form a flap, similar to the superior one, when the diseased bone or bones, can be drawn from the bottom of the wound, by a linen retractor, and sawed ; the ulna should never be removed lower than the attachment of the brachialis anticus, nor ought the radius be sawed below the tubercle to which the biceps flexor muscle is attached. It will be immediately seen that serious injury would supervene if the insertions of those two muscles were cut away. Though Moreau has advocated the necessity of the second or inferior flap, I am confident that the diseased portions, both of the ulna and radius can be extirpated by the cutting pliers, as low as the insertion of the muscles already alluded to, without any such division of the soft parts on the back of the arm, as counselled by the French authority. A few small vessels derived from the articular arteries, may require the ligature, previous to arranging the flaps ; which are to be treated in the manner just mentioned.

This operation is essentially the one performed by the elder Moreau, in which the triceps extensor cubiti is sacrificed.* It is conceived

* This operation was revived some years since by Mr. Crampton :

possible, to preserve the attachment of this muscle, and so continue its uses to the patient, by making but two incisions, one internal, and one external, and to omit the transverse incision; the chain saw is then to be introduced so as to encircle the humerus, and cut through it; the lateral ligaments are next to be divided, which allow the diseased bone to be removed from its situation.† This proceeding is not very difficult on the dead body: how can it be performed in the living?—where the joint is considerably swollen, the soft parts more or less indurated, from repeated attacks of chronic inflammation; if the articulating surface of the ulna is diseased, the olecranon process must be sacrificed, thus defeating the object intended. I am fearful, it is attempting refinements that cannot be attended with any advantage to the living.

This operation may be so modified, as to extirpate a part of the inferior extremity of the humerus, as in cases of gunshot wounds, causing partial injury to the joint, also in partial caries of the bone.

Anatomy of the Elbow Joint. This articulation affords us one of the best examples of the ginglymoid kind, resulting from the adaptation of the ulna to the inferior extremity of the humerus, which admits of no

I am not aware that he has published any of his cases; but the reader will find in the Edin. Med. Surg. Journal, vol. xxxi. 1829, and in the numbers for April, and July, 1830, the details of many cases of this operation, by M. Syme, which are worth perusing.

† Jeffray on Carious Joints.

motion, but flexion and extension; whilst all those connected with rotation, are dependent on the radius which also enters into the joint.

The ligaments that connect the two bones of the forearm to the humerus are, two lateral, and a fibrous capsule, lined by a synovial membrane; the radius and ulna at their humeral extremities, are connected to each other by an annular ligament, also by one named the oblique. The external lateral ligament, is a strong but indistinct band of fibres, attached to the epicondyle, or external tuberosity of the humerus, and is inserted into the annular ligament of the radius; it is very little affected in any position of the joint. The internal lateral ligament, arises from the epitrochlea, and passes in a fan shape, to be inserted into the ulna, by a convex line, that extends from the coronoid to the olecranon process; the anterior part of it is rendered tense, when the forearm is extended, while the posterior portion becomes flaccid; the reverse is perceived during the flexed state of the joint; the fibrous capsule is very thin, but is found strongest on the anterior and posterior part of the joint, where it is also very lax, to favour the motions of it.

The remaining ligament, which I wish to direct the student's attention to, is the annular, which has been already alluded to; it is seen to arise from the anterior edge of the lesser sigmoid cavity of the ulna, encircle the neck and head of the radius, for three parts of their circumference, and to be attached to the posterior part of the same cavity; for obvious reasons this ligament ought never to be sacrificed, for the consequence will be, that the union between the two bones will be so weakened, as to render the future motions of the forearm very imperfect.

This articulation is covered in a very unequal manner by muscles, and other soft parts, which shew that it can be exposed with safety and ease only at one aspect, namely, the posterior ; for example, at the anterior part of the joint, and subjacent to the integuments, are the numerous anastomoses of veins, derived from the communications of the cephalic, median, and basilic ; lying on the same plane with them, are the internal and external cutaneous nerves : to the external side of the joint is placed the mass of muscles that constitute the supinators of the forearm, also some of the extensors of the hand ; in the centre of the bend of the arm, the biceps flexor cubiti, and the brachialis anticus, are situated, the first inserted into the tubercle of the radius, and the second into the base of the coronoid process of the ulna : at the internal side of the articulation, the pronator radii teres, and the flexor muscles are placed.

In addition to these parts, we also observe, at the anterior surface of the articulation, and in contact with the brachialis anticus, the humeral artery, and median nerve, with branches from the anterior ulnar recurrent artery, situated internal to the tendon of the biceps ; whilst at its external side are found the musculo-spiral nerve, and some branches from the anterior radial recurrent artery.

The posterior surface of the joint, is covered by very few parts, when compared with the anterior ; these are, the triceps extensor cubiti muscle, inserted into the olecranon, the ulnar nerve, which descends behind the internal condyle to the forearm, in this position it can always be found ; in the same region, the posterior ulnar recurrent artery ascends in close contact with the interpal lateral ligament, to anastomose with the inferior pro-

funda; while behind the external condyle are some branches from the interosseous recurrent artery.

From this view of the anatomy of the joint, it is evident that no surgeon will ever think of removing the diseased portions of the elbow joint, from the anterior part of it, in consequence of the great depth of the coverings, and the multitude of arteries and nerves in this situation; any attempt to effect it, must be rash in the extreme, and a complete failure be the result: on the contrary, by undertaking it from the posterior aspect, there is but one muscle intervening between the skin and the joint, scarcely any artery worth bestowing a thought upon, and but one nerve, the ulnar, the course of which is so certain, that it cannot be injured by the operator.*

Excision of the head of the Humerus. This operation is called for in similar cases as that of the elbow joint, as scrofulous affections, and in some cases of gunshot wounds; from numerous successful terminations of this operation, it promises in some measure to supersede that of amputation in the shoulder joint, thereby preserving for the sufferer a useful limb.

To what has been already said on the anatomy of this joint, which will be found at page

* In one of Mr. Syme's cases (Elizabeth Johnston) it was partly cut across; he completed the division, to avoid the danger resulting from such a lesion, and laid the ends in contact: they appear to have united. This accident is more likely to occur according to this gentleman's style of operating, than in the one described in the text—as he cuts directly into the articulation, without the previous formation and reflection of the flap.

172, I merely wish to point out to the reader, the situation of the long head of the biceps, which he will find in the bicipital groove towards the internal side of the articulation; if possible it ought not in any case to be cut across, as the future motions of the limb will be much injured, if it is sacrificed.

Three methods are presented to the operator to select from, to extirpate the head of the humerus:—*1st*, the semilunar flap; *2nd*, the V shaped flap; *3rd*, the simple linear incision.

First plan. If the semilunar flap is adopted, the surgeon examines for the situation of the coracoid process of the scapula; opposite to it he commences the cutaneous incision, and carries it with a gentle curve to the external side of the arm, till it terminates a little posterior to the acromion process; the lowest point to which this incision should extend is midway between the acromion process and the insertion of the deltoid into the humerus; the muscles are next to be divided, and the flap raised; when the tendons of the supra and infra spinati muscles, with that of the teres minor, are brought into view, which are also to be divided. Rotation of the humerus outwards, exposes the tendon of the subscapularis, which is to be separated from the lesser tuberosity, in effecting which, the long tendon of the biceps will be endangered. The head of the bone being now freed from all its connexions, and the capsule opened, it can be luxated from

the glenoid cavity, by using the humerus as a lever of the first order; if much difficulty is experienced to effect this object, it will be incumbent to cut through a part of the insertion of the pectoralis major, the latissimus dorsi, and teres major muscles, when the bone can be dislocated with great ease; a piece of card or a metallic plate being introduced between it and the soft parts, effectually protects them from the action of the saw, which ought not to be applied lower than the surgical neck of the humerus. Some branches of the anterior and posterior circumflex arteries, may require a ligature, and the bone is then to be replaced.

Second plan. The V shaped operation is to be performed in the following manner:—the arm being allowed to hang by the side of the trunk, or very slightly raised, the first incision is to run parallel to the posterior edge of the deltoid, and descend as low as the insertion of that muscle; the anterior incision is to commence at the acromion process, and pass through the centre of the deltoid till it falls into the first; the flap formed by these incisions is to be raised from the bone, and thrown on the scapula; there are then exposed; the posterior circumflex artery and nerve, also the insertions of the supra and infra spinati with the teres minor muscles, which are to be divided, as well as the process of fascia sent up from the pectoralis major to the capsule of the joint; it being opened, the operation is to be finished as in the preceding one.

Third plan. Finally, the head of the humerus can be extirpated by means of the linear incision, which is to divide the deltoid muscle, for the entire of its extent from the acromion process to its insertion into the bone; the lips of the wound are next to be separated as much as possible, to facilitate the remaining steps of the operation, which have been already described in the preceding methods.*

Observations. The semilunar flap operation, is best adapted to those cases in which the head of the humerus is much enlarged, and the soft parts that surround it considerably indurated; as by it, more space is afforded for prosecuting the subsequent stages of the dissection, and removal of the diseased head.

In this operation, the deltoid muscle is more injured than in the other two, as it is cut transverse to its fibres, which may induce some surgeons to reject it altogether. This necessary lesion is but a secondary consideration, when contrasted with the benefits that may arise from its adoption in those cases which really demand the semilunar flap operation.

The surgeon, by taking advantage of the second plan, or V shaped flap, always has it in his power to prevent any excessive haemorrhage; as, he can secure the posterior circumflex artery before it is divided; which he always finds to wind round the humerus, below the insertion of

* The reader is referred, for further information, to White's Cases in Surgery, p. 57. Larrey's Chirurg. Militaire, tom. ii. p. 173. Guthrie on Gunshot Wounds, p. 454. M. Morel's Case, Med. Chirurg. Transactions, vol. vii. p. 161. M. Syme's Cases in Edin. Med. Surg. Journal, vol. xxvi. p. 49.

the teres minor, surrounded by a large quantity of cellular membrane; it is invariably accompanied by the nerve, which, by some management, the operator may be also able to protect from much injury, at least many of the large branches, unless considerable disease is present; which may so mask the parts as to obviate the intentions of the most skilful operator.

The last operation is alone applicable to recent cases of injury, as when the head of the bone is comminuted, and where the soft parts are not yet consolidated by inflammation; an incision of this kind may then be sufficient to afford ample space for exposing the deep-seated parts, so as to admit of the removal of the shattered portions of bone; while, on the contrary, when the soft parts have been indurated and consolidated by repeated inflammatory attacks, the most satisfactory operation will consist in selecting the semilunar flap.

Extirpation of the head of the Femur. This operation has been performed but in two or three instances; the only authentic case with which I am acquainted is that by Mr. Hewson of the Meath Hospital, which he performed some months since.*

It is said that Mr. White of the Westminster Hospital removed the head of the femur in two cases, one of which succeeded.

Excision of the Knee Joint. The extirpation of this joint was first advocated, and performed by the late Mr. Park, of Liverpool; though successful in one case, surgeons considered it so unfavourable that, from his time, 1781, till within

* For an Account of this Operation see APPENDIX.

these few years, we have not heard of its being repeated, when Mr. Crampton* revived it. He performed both his operations as follows:—an incision was made about three inches above the external condyle, and a little below the axis of the femur, which was continued to about one inch below the head of the fibula. A similar incision was made on the inner side of the joint; these were united by a transverse cut, carried below the patella. The flap thus formed, was raised by a rapid dissection, and the cavity of the joint completely exposed: then, at the place where the periosteum was united to the bone, the saw was applied, and it divided, the soft parts being protected by a spatula, which was passed between the muscles and the bone. The inferior part of the femur was then easily detached from the soft parts on which it rested, the lateral ligaments cut through, and the condyles removed. The semilunar cartilages were next cut away, and if any portion of the tibia was diseased, it was pared off, by means of a short strong knife. When the flap was laid down, it was found to be too long by three inches, which were cut away, including the patella, to allow the remaining part to be more easily adapted to the rest of the wound, and the limb placed in the horizontal position.

From some difficulties encountered in his se-

* Dublin Hospital Reports, vol. iv. for Mr. Crampton's Paper. Edin. Med. Surg. Journal, April, 1830, p. 235, Mr. Syme's two Cases.

cond operation Mr. C. advises, before sawing the bone, to cut the ligaments which connect the condyles of the femur to the bones of the leg, which will allow the end of the femur to be protruded from the wound, at the same time that the leg is carried backwards, when the bone can be sawed without any difficulty or delay: I have adopted this on the dead subject, and find that the operation is much facilitated by it.

Anatomy of the Knee Joint. This joint furnishes us with an example of the ginglymoid species; portions of three bones, directly compose it, as the broad expanding condyles of the femur, the head of the tibia considerably enlarged to receive them, and the patella, which surmounts the condyles; whilst the head of the fibula is indirectly connected with it. Besides strong aponeurotic expansions derived from the fascia lata of the thigh, it is also strengthened by an internal and external lateral ligament, which are subcutaneous; the ligamentum patellæ is of some service in this respect: we observe the mechanism of this articulation further increased in firmness by the two crucial ligaments, that may be considered as placed in the interior of it: on the posterior aspect of the joint the ligamentum posticum of Winslow, or the tendinous band derived from the semi-membranosus muscle, aids the parts already mentioned, and renders them more capable of performing their offices. The articular cavities of the tibia are deepened by the two semilunar cartilages.

The knee joint anteriorly and laterally, may be considered as perfectly subcutaneous, affording no parts of any moment to the operator to avoid, but the ramus anasto-

moticus artery, the last of any magnitude given off by the femoral, the saphenus nerve, and saphena vein, which pass along the knee, about the centre of the lateral aspect.

The posterior part of the articulation, is the most important to be considered, as we observe the great sciatic nerve, the popliteal vein and artery, the latter in close contact with the bone; to the external side of this region, the tendon of the biceps flexor cruris is placed; whilst to the internal, the tendons of the semi-membranosus, and tendinosus m., descend to their insertions, and more anterior to them, those of the gracilis and sartorius. In extirpating this articulation the attempt should always be made from the anterior aspect, for the same reasons that that of the elbow is always from the posterior.

Removal of the inferior extremities of the Tibia and Fibula. Again we have M. Moreau the father, leading the way in this particular point of practice, in cases of caries affecting the fibula and astragalus, and with successful results.

It is also advised by Sir A. Cooper, as a proceeding productive of much benefit, and is called for from the following considerations:—*1st*, from the great difficulty experienced in reducing the luxation; *2nd*, if a very oblique fracture is present, it will prevent the bones remaining *in situ*, whilst if this portion is sawn off the difficulty will be removed; *3rd*, spasms will be obviated; *4th*, local irritation will be diminished, and better prospects of adhesion taking place; *5th*, suppuration and ulceration lessened; *6th*,

there will be less constitutional irritation ; 7th, it has been found by experience, where the bones forming a joint have been broken into many pieces, when they have been removed, the patient has suffered less, and has more quickly recovered, than when the splintered portions of the bones have been replaced ; 8th, finally, Sir A. Cooper affirms that he has known of no instance in which death followed, when the bones have been sawn off, though he has seen cases terminate fatally, when this was not done.*

No definite rules can be laid down for this operation, as the plan of proceeding will mainly depend upon the state of the parts after the accident; in fact, the operator will be guided by the circumstances of the case : he will, however, be attentive not to injure any of the tendons, nor the vessels and nerves, the largest of which lie behind the internal malleolus : after the operation, the greatest attention should be paid to control the inflammation.

The following extract is taken from M. Jeffray's work on Carious Joints, as the way in which Moreau removed the inferior part of the fibula, tibia, and part of the astragalus :—

“ He made a longitudinal incision, beginning at the inferior and posterior part of the malleolus internus, continuing it upwards, from three to four inches. He then made another incision,

* Sir A. Cooper on Dislocations, p. 278, *et seq.*

transverse, which extended from the inferior end of the former incision, to the edge of the peroneus brevis. He made another longitudinal incision, on the inside, which began at the inferior and posterior part of the malleolus (internus), and extended from three to four inches along the internal border of the tibia. Then, by a third incision, which began at the lower end of this, he cut the skin transversely, till he came to the end of the tibialis anticus. He disengaged the fibula from the tendons, the ligaments, and, in general, from every thing by which, at its inferior extremity, it is held in its situation. He passed the handle of a scalpel under it, and with a chisel, he cut it across, above the ankle. Perceiving that the bone was affected, still higher up, he took away six lines more. Wishing to cut the tibia above the malleolus, before he turned it out of the joint, he separated every thing that adhered to it; and then passing the handle of his scalpel between the posterior surface of the bone and the flesh which had been detached from it, he introduced, between the spine of the bone and the flesh before the bone, the blade of a narrow saw, fixed in a handle, and cut the bone, sawing from before backward, which was a work of no small trouble. That being done, he turned the foot outward, and, making the piece of bone which he cut off, project, he detached it from the tarsus, without difficulty. The astragalus being diseased, he re-

moved the whole of its articulating surface, and a great part of its body, till he came down to 'what was sound.'

The foot and leg were then dressed, and the patient put to bed. I am free to confess that the *modus operandi* in this case is not very intelligible. The patient ultimately recovered. I have never witnessed an operation of this kind.

Removal of the Astragalus. When the astragalus is luxated, it is almost impossible to reduce it, as it offers no dimensions which will allow it to be used as a lever for that purpose; if permitted to remain in the unreduced state, in all probability the bone will excite such inflammation, as will ultimately cause it to slough out from its cavity, having previously produced considerable suffering to the patient.* Surgeons, instructed by such endeavours of nature, to rectify the derangements that succeed to accidents of this kind, have been induced to extirpate it, when dislocated; and I believe in most cases, the practice has been followed by a successful issue.

The method to be adopted for removing the astragalus, will depend in a great degree on the manner in which it is displaced in the articulation, and for which no precise directions can be given; prior to attempting the operation, it will be necessary to recollect the course of the ves-

* Cooper on Dislocations, fifth edit. p. 336, plate xx. Hey's Surgery, third edit. p. 383.

sels and nerves, which can always be protected by paying but common attention to their situation ; when the bone is laid bare, it ought to be seized by a strong forceps, and the fibro-cartilage that unites it to the os calcis being cut across, it will be brought away with but little difficulty : after which the flaps are to be arranged, and the limb placed in proper position.

In a case that I witnessed of this operation, in the Meath Hospital, and to which I was dresser, the patient was able to walk in eight weeks, and ultimately had as much motion in the ankle joint, as if he wore a boot that was tight across the instep ; the injured leg was about an inch and a half shorter than the sound one.

In some instances, other bones of the tarsus, and metatarsus, have been extirpated with considerable benefit to the patient : for two encouraging operations of this nature, the reader is referred to Mr. Dunn's* case, who removed the cuboid and navicular bones, the three cuneiform and the metatarsal bones of the second and third inner toes ; and to Mr. Key's,† who has amputated the four smaller toes, with their metatarsal bones, the two outer cuneiform, and the os cuboides ; leaving the calcis, astragalus, navicular, and internal cuneiform bones, with the metatarsal bone of the great toe, and the toe itself.

* Med. Chirurg. Transactions, vol. xi. p. 337.

† Cooper's Lect. by Tyrrell, vol. ii. p. 424.

Anatomy of the Ankle Joint. The astragalus, which transmits all the weight of the body from the leg to the tarsus, is received into a cavity formed by the tibia and fibula, at their inferior extremities, and is attached to them by means of the deltoid, and external lateral ligaments; while it rests upon the os calcis, and is intimately connected to it, by a powerful fibro-cartilage, that stretches from the groove on the inferior surface of the astragalus, to that on the superior one of the calcis; the anterior part of the astragalus is terminated by a head, which is lodged in a corresponding cavity of the os naviculare, which is considerably deepened by the calcaneo-scaphoid ligaments; in addition to the ligaments already described, the articulation is fortified by numerous fibrous bands. The motions of the astragalus on the tibia and fibula, presents us with one of the best specimens of the hinge joint; whilst it moves on the calcis, and naviculare, simply by a gliding motion.

This articulation is covered anteriorly by the extensor tendons of the toes, the anterior tibial vessels and nerves; internally and posteriorly, the tendons of the tibialis posterior, flexor digitorum longus, and flexor proprius pollicis pedis run in grooves afforded by the internal malleolus and the astragalus itself; also on this aspect, are the posterior tibial artery, veins, and nerve, whilst the malleoli descend on each side of the astragalus.

Observations. Those operations are confessedly of great utility, in the scapulo-humeral, elbow, and metacarpo-phalangar articulations of the thumb; from the cases published, we have the satisfaction to observe, that the almost perfect motions of the extremity have been restored to the patients; but of those performed on the

inferior extremities, as in the hip and knee* joints, the success has by no means equalled similar operations on the upper extremities; with the exception of the extirpation of the astragalus.

This is not a matter of much surprise, when the mechanism of the superior and inferior extremities are compared with each other; the superior being used merely as prehensile organs, and scarcely ever destined to support any weight, are not sensible, or scarcely affected by the imperfections in the mechanism of the new joints, which it is the intention of the operation to afford in place of the natural ones; on the contrary, the inferior extremities being to a great extent originally destined to support the trunk, the rude articulations derived from operations of this kind, are by no means competent to bear up against the continued friction to which they are liable, and must of necessity expose them to repeated attacks of inflammation; as I conceive it next to an impossibility, for the surgeon to procure such firm union where the hip or knee joints were originally situated, as to prevent a false articulation being formed. I also feel convinced, that the firmness with which an individual rests upon an extremity so circumstanced, cannot be compared with the decided stability that a person enjoys, who depends upon the ordinary wooden leg for his support.

Even in the case of Mr. Crampton, which may be

* This operation has been performed seven times; once by M. Moreau, twice by Mr. Parks, twice by Mr. Crampton, and the same number by Mr. Syme; Moreau's case failed, one of each of the other gentlemen was successful.

considered as successful, the girl was obliged, when I saw her two years after the operation, walking the corridors of the Meath Hospital, with very trifling assistance derived from a hand crutch, to have that part of the limb corresponding to the knee, strapped round with very strong unyielding leather, to prevent the extremity "buckling," during progression; finally, when we consider the difference of time between the ultimate union of the soft parts, in this operation, and amputation, it will be considerably in favour of the latter.

CHAPTER VII.

EXTIRPATION OF SOME ORGANS—REMOVAL OF SOME CONGENITAL DEFECTS.

EXТИRPACTION OF THE EYE. Fungus haematoxides, in the very commencement of its development, cancerous affections of the globe, and some anomalous diseases, are those which most frequently require this operation. The patient being seated upon a chair, and the head firmly supported on the breast of an assistant, who places one hand under the chin, and the other on the top of the head, with which he can elevate the lid of the diseased organ, and in this way afford much assistance to the operator; who

stands in front of the subject, and with a long narrow-bladed scalpel, divides the external commissure of the lids, for about half or one inch in extent; he then passes a ligature or tenaculum through the cornea, to draw the eye gently outward, according as it is detached from the upper lid, by dividing the parts from one commissure to the other; in proportion as the globe is separated from its connexions, the assistant raises the lid: the same proceeding is to be followed as regards the adhesions of the lower lid to the eye, which the operator depresses according as they are divided.

By pursuing this method, the conjunctiva and proper muscles of the eye are divided, and the organ is retained solely by the optic nerve, and some cellular membrane, which can be cut with the scalpel, or if the operator wishes, with a curved scissors, introduced into the fundus of the orbit. The lachrymal gland then remains to be removed, which is situated at the superior and external part of the orbit; no difficulty is experienced in effecting this object. If the lids be diseased, they should be also extirpated, at the same time that the eye is being removed. In the living subject, the cavity of the orbit is to be cleared of the cellular membrane, which may partake of the disease, and then filled with lint, and the sanative processes of suppuration, granulation, and cicatrization, encouraged.

Observation. The immediate deformity consequent to this operation is very great, but in a few days a small reddish peduncle rises from the fundus of the orbit, which will support the lids, and obviate it: if the patient has recourse to an artificial eye, no deformity whatever will result from the extirpation. For dividing the optic nerve, and whatever soft parts may connect the eye to the bottom of the cavity, a curved scissors is recommended by surgical writers; if the operator will use the knife above described, he will be able to accomplish the ablation of the entire contents of the orbit with facility, without having recourse to any other instrument.

Extirpation of the Lachrymal Gland. This organ, which is situated at the anterior, superior, and external part of the orbit, is sometimes affected with cancer, independent of any disease of the eye, for which the operation of its removal is demanded; or the gland may become so enlarged as to protrude the eye from its cavity, causing not alone considerable distress to the patient, but serious injury to the organ, perhaps loss of vision.

The operation may be performed as follows:—the patient either sits on a chair, with the head supported by an assistant, or is placed on the back with the head a little elevated; a lunated incision, the convexity regarding the superior margin of the orbit, is to be made through the integuments of the upper lid, and of sufficient extent, as will allow the tumour to be fairly exposed on its anterior aspect, the orbicularis pal-

pebrarum muscle, and the tarsal ligament, on being divided to the same extent as the superficial parts, will admit the entire of the anterior surface of the tumour to be denuded, by a careful dissection, which is then to be separated from its deep connexions, observing to protect the eye, and taken away.*

To open the Lachrymal Duct, in fistula lachrymalis. The subject having the head supported by an assistant, or laid on a table, the surgeon stands before him and draws the external canthus of the lids outwards, which renders them and the tendon of the orbicularis palpebrarum tense; he then passes the index finger of the right hand inwards, along the inferior margin of the orbit, until it is arrested by the ascending or nasal process of the superior maxillary bone, at the internal angle of the eye; guided by this point and the tendon of the orbicularis m., he is certain to enter the sac, by placing the point of a fine narrow scalpel (the back regarding the nose,) im-

* Two interesting cases of this operation, one by the late Mr. Todd, the other by Mr. O'Beirne, will be found in the Dublin Hospital Reports, vol. iii. p. 418.

In Mr. Todd's case, after the superficial incisions were made, the tumour was so firmly wedged in the orbit, that considerable difficulty was experienced in detaching it; however, by proceeding with caution, partly dividing some fibrous bands which connected it to the subjacent parts, and tearing the cellular membrane, he removed the entire of the gland, which was larger than a full-sized walnut. In both these cases the operation was successful.

mediately below the tendon, and internal to this portion of the orbital margin, which he forces downwards and a little inwards, thus readily opening into the sac; the knife remains in it, until he introduces a fine probe into the cavity of the canal, which he directs downwards, a little outwards and backwards.

Mr. Burns, in his work on the *Surgical Anatomy of the Head and Neck*, urges the propriety of examining the nasal duct from below upwards with a probe; this species of sounding, I believe, is seldom resorted to at the present time: however, if the student wishes to practise the operation, he can avail himself of Mr. Burns' directions, which are given in the note at the foot of the page;* he will find it a more easy matter to

* The introduction of the probe is not generally difficult, yet I have seen several foiled in their endeavours to pass it. They attempted by force what they ought to accomplish by artifice; they endeavoured, without an acquaintance with the mechanism of the parts, to do what only can be done by one familiar with the organization. The position of the orifice of the nasal duct, and the after course of the canal, ought to be carefully studied, because the probe must be adapted to the curve of these parts. It is to be passed by gentle efforts; force must never be employed. I pass the probe along the floor of the nostril, with its concavity directed toward the antrum, and its convexity looking toward the septum of the nose. I carry it on in this course, till I feel that its point has passed beyond the ascending plate of the jaw bone; then I rotate the probe between my fingers, till its point looks upward and outward toward the eye. While the probe is making this turn, it is of consequence that its point be maintained in close contact with the side of the nostril. When

introduce a fine gum elastic catheter, armed with a stilette, which is more pliant, and better adapted to accommodate itself to the course of the canal, than a silver probe.

Cancer of the Lip. This affection demands two different methods of operation, according as it occupies a narrow or wide part of the lip; for instance, it may appear as a small warty excrescence, or ulcer, a simple cleft or fissure, as a hard granular nodule: or, finally, the disease may extend from one angle of the mouth to the opposite, engaging the whole of the lower lip. The surgeon can modify his operation, to meet the varieties just mentioned; having placed his patient in a suitable situation, with the head supported by an assistant, who compresses the facial arteries as they ascend the inferior maxilla in front of the insertion of the masseter muscles; the operator takes hold of the lip with the thumb and fingers of the left hand, and draws it up from the bone, so as to render the parts tense

this turn is completed, the handle of the probe is to be gently depressed, while its body and point are elevated. This motion conveys its point into the orifice of the nasal duct, and carries it up into the lacrymal sac. If the duct be free from obstruction, this is generally readily accomplished; but it must be mentioned, that where the lining membrane of the nostril is preternaturally loose and pendulous, the point of the probe sometimes catches a fold of it, which is carried into the orifice of the duct, where, as a valve, it hinders the further progress of the instrument. This obstruction is most easily overcome, by retracing the probe a little, and moving its point slightly away from the side of the nostril, p. 335.

through which the knife is to pass; an assistant holds the opposite side in a similar position, while the surgeon removes the disease by including it in a V shaped incision.

Some prefer the scissors for this purpose; they are not to be compared to the knife, as they confuse the soft parts at the time of their being divided, which interferes considerably with the process of union by the first intention; always a desideratum in this operation.

If much of the lip has been removed, the surgeon then detaches the remaining parts from the gums, which favours the approximation of the edges of the wound, and allows them to be more easily retained in contact, by means of two needles passed through the lip, as near as possible to the mucous membrane of the mouth, by which the divided coronary arteries will be placed in direct apposition, and secondary haemorrhage prevented; the twisted suture is then applied.

Some practitioners prefer two or three points of the interrupted suture to the needles: whilst others use but one needle, which is applied as close to the edge of the lip as is consistent with the safety of the soft parts, and one point of suture near the angle of the incision.

If the disease is superficial, and occupies much of the surface of the lip, it may be removed by cutting it away lengthwise from the subjacent parts, which will in a short time cicatrize, and form a lip nearly as perfect as the original. We

are indebted principally to M. Dupuytren for this improvement in treating the disease in question; who was led to adopt it from considering that cancer was a disease in the part, not of the part; by the presence of which, the natural formation of the lip was either destroyed, or forced from its situation, as it acted like a foreign body, and pressed the structure of the parts from their natural position, which would be restored as soon as they were relieved from this substance.

After the ablation of the cancer, the surface of the lip is to be covered with simple dressing; in a short time it will cicatrize, leaving no deformity.*

Excision of the mucous membrane of the Lips. In some individuals this membrane presents a very prominent appearance, amounting in many cases to actual deformity; and may depend on the frœnum labii being too long, or on what may be considered an hypertrophy of the mucous membrane; sometimes the labial glands are increased in volume, from the habit of biting or sucking the lips, and give origin to this state. If it arises from the frœnum being too long, removing a portion of it will obviate the deformity; whilst if it is caused by enlarged labial glands, their excision will remedy it, without leaving any evident cicatrix:—it may be effected by raising them

* Doctor Bull, of Cork, successfully treated this disease on this principle—so did Mr. Crampton of this city.

with a forceps, and cutting them away with a curved scissors; if any remain, it will be necessary to dissect them from their connexions with a scalpel; after a few days the wound cicatrizes, and the deformity is completely removed.

Removal of the deformity resulting from Hare Lip. The operation for this affection is to be regulated according to the malformation that is present, as it affects the lip, the hard, and the soft palate; of which six varieties can be enumerated; one of them demands a particular operation, named staphyloraphia.

These varieties are, 1st, a simple fissure, that extends from the edge of the lip to the nostril; 2nd, the fissure may be more extensive, and pass into the nostril; 3rd, there may be a fissure penetrating into each nostril; 4th, the single fissure may pass through the palatine processes of the superior maxillary and palate bones, implicating the soft palate, and admitting of a free communication between the mouth and nose on that side; 5th, there may be a fissure, implicating similar parts on each side of the septum narium, as is mentioned in the preceding variety, the septum being perfect, with a free communication between the mouth and each nares; 6th, includes that modification of this malformation, where there is a deficiency in the soft palate, either a circular opening, or a fissure, the lip being perfect.

In the two first varieties, the operation is very

simple, and is almost invariably successful; as the great object in it is to obviate congenital malformation, and to prevent artificial deformity, the surgeon must be careful when paring the edges of the fissure, that it is done with such exactness as will leave the fresh and recent edges of the wound even, and so fitted to each other, that they will precisely correspond and unite without any irregularity when placed in contact, so as to have but a simple line between them.

In order to accomplish such a union, the operator will arrange in his mind the different steps of the operation, to meet any obstacle that may occur; for which purpose, some surgeons are in the habit of marking each side of the fissure with dots of ink, to indicate by this means the exact relations of the sides of the wound to each other during the operation; this practice is of some use, but as they may be washed away or obscured by the blood, it is safer for him to depend upon his eye, and correct the line of incision by it, than to confide in any marks of this kind. After the patient is properly secured; the surgeon examines if there are any intimate adhesions between the lip and the gums, or if a tooth projects into the fissure, these are to be removed; he then pares away, either with a scalpel or a scissors the cutaneous edge of each side of the fissure, and makes an even regular wound of it; the edges he then brings into contact, and retains them, either by suture or by the needles. See page 283, for the manner of applying them.

In the third variety, where the centre portion protrudes almost as an insulated prominence, if very small, it is to be cut away, which will convert the malformation into one fissure, whose edges are to be pared and united as already indicated. If this proceeding be considered inexpedient, in consequence of the magnitude of the centre portion, it will be necessary to perform two separate operations, and at distant intervals, to allow the first to be completely united, before the second is attempted; if the surgeon is not content with this necessary delay, but cuts away the centre mass, and attempts the cure by one operation, I am confident that he will have cause to regret such a proceeding, and will be much embarrassed in the after treatment.

In some cases where a portion projected between the two fissures, Desault tried the effects of compression on it for a few days previous to operating, which caused the mass to recede and be on the same plane with the other parts of the lip: he then proceeded to operate, and experienced no difficulty in producing a radical relief of the affection.*

Some surgeons deem it necessary for the first forty-eight or sixty hours after the operation, to support the newly divided parts by adhesive plaster; whilst others assert that the union takes

* Œuvres Chir. de Desault, tom. ii. p. 206.

place more rapidly and firmly, when the wound is exposed freely to the air.

In those cases, where only a small part of the palatine plate of the superior maxillary bone is deficient anteriorly, if the union of the lip is effected in early life, the osseous fissure will generally be obliterated, or so far relieved, that the patient will not be inconvenienced by it. But if the deficiency extends through the hard and soft palate, though the prospect of success be not great, still the operation should be undertaken.

Staphylorraphia. The operation known by this denomination, refers to the congenital division of the soft palate from its free to its attached edge; the numerous cases in which it has been tried and succeeded, justify us in introducing it as a legitimate branch of Operative Surgery. There are two very celebrated surgeons, M. Roux of Paris, and Mr. Graëfe of Berlin, contending for the honour of inventing this proceeding; without assuming the office of an umpire between them, it is more congenial to my feelings to bestow my meed of approbation on these gentlemen, not alone for this improvement, but for the many others which they have introduced into surgery, and shall proceed with the operation.

The instruments necessary for the operation, are a long narrow-bladed knife, being not more than one quarter of an inch wide, and from five

to six inches long, a *porte aiguille*, short curved needles with triangular points, waxed ligatures, forceps and hooks.

The patient being seated on a chair, the face regarding the light, and the head thrown back, and supported by an assistant, will open his mouth as wide as possible, to allow a piece of cork to be placed between the last molar teeth on each side, to maintain it in that state. The surgeon then seizes with a forceps one of the sides of the fissure, and fixes it; a curved needle, armed with a ligature, is next to be conveyed, posterior to the palate, by means of the "*porte-aiguille*," and to penetrate through it from behind forward, about three lines from the edge of the fissure; the needle, with the ligature, is then withdrawn, by means of the forceps; this proceeding is to be repeated on the opposite side of the cleft; a second, and a third ligature, is to be passed through the palate, in the manner already described: seldom more than three are required.

The ligatures thus placed; one near the superior angle, one close to the inferior part of the cleft, and the third almost midway between them, are to be brought out of the mouth; the operator next proceeds to pare the sides of the cleft with the long knife (also of the hard palate if it is implicated in the malformation) after which he is to draw the ligatures together, be-

ginning with the one nearest the angle ; tie them, and cut them close to the knots.

Observations. As the patient, after the operation, must remain for some hours (from forty to fifty) without food of any kind, it will be necessary to give him a moderate supply prior to commencing it, and allow a few hours to elapse after it has been taken, to permit any irritability of the parts engaged in deglutition, to subside ; if this is not attended to, but the operation is proceeded in shortly after the repast, the surgeon will find the parts in such a state of excitement, that vomiting will be induced, which will compel him to desist, and to wait for a more favourable opportunity.

The surgeon who undertakes this operation, as well as the patient, ought to come prepared with an abundant stock of patience ; the first will be compelled repeatedly to desist, owing to the frequent spasmodic attacks of the parts engaged in the operation, nearly amounting to vomiting ; the haemorrhage will also annoy him ; one of the best means to arrest it will be by the affusion of cold water ; those delays will be trying to the patient ; however, they can all be surmounted by a little endurance.

The great success of *staphyloraphia*, will mainly depend on the patient preserving the parts that have been submitted to the operation in the most absolute state of quiescence ; the strictest abstinence ought to be observed for several days, and no solid nourishment whatever allowed : in fact, nothing ought to done which will call the muscles connected with the soft parts engaged in the operation into action. After the fourth or sixth day, the ligatures are to be cut away ; still the patient ought to

be enjoined to maintain the parts at rest for seven or eight days after the removal of the ligatures.

Mr. Roux has performed this operation forty-seven times ;* it has also been executed by many other practitioners.†

Enlarged Amygdalæ. These glands are situated between the pillars of the fauces, being of an oval shape, their greater extremity looking upwards, and the lesser downwards to the tongue ; one edge projects a little into the isthmus faucium, while the other passes in an opposite direction, and is in close contact with the internal carotid artery, being separated from it by a part of the superior constrictor pharyngis muscle, which is very thin ; the surfaces of these bodies look backwards and forwards, being bounded by the palatine arches.

Attacks of inflammation often cause the formation of abscess in the amygdalæ ; if frequently excited, they may produce chronic enlargement of them ; the glands will then project into the fauces, causing much inconvenience to the patient such as impeding the respiration, deglutition, and even the articulation of speech ; not unfrequently partial deafness attends this increase in size.

Such consequences call for the extirpation of

* Revue Medicale, Jan. 1830, p. 18.

† London Med. Reposit. 1824, for Mr. Alcock's case, the first attempted in England.

the projecting portion ; which may be readily accomplished in the following manner ; the patient's mouth being opened, and retained so by a piece of cork placed between the teeth, or any hard substance, the surgeon takes hold of the gland with a hook, and draws it forwards from between the palatine arches into the mouth ; whatever portion passes beyond them, may be safely shaved away, parallel to their edges, with a probe-pointed bistoury, cutting from below upwards.

Many surgeons dread this operation, in consequence of the vicinity of the internal carotid artery : if the projecting part be alone removed, in the way now mentioned, not the least danger will be incurred of wounding the vessel. Sometimes the operator experiences much difficulty during the operation, from the great tendency to vomit, when the gland is drawn forwards.

The projecting part of the amygdala can be also removed with a strong scissors, blunted at the extremities, it being previously drawn from between the pillars of the fauces.

A pointed bistoury ought never to be selected for this purpose ; for, if the patient should push the head forwards, it may penetrate the posterior part of the pharynx, and open the internal carotid artery.

A case is noticed from Beclard in the Dict. de Medecine, where an itinerant operator excised the amygdala with a sharp-pointed bis-

toury ; the patient died, in a few hours, of hæmorrhage ; the internal carotid had been opened.

If it be necessary to open an abscess in either of the tonsils, provided the surgeon sheathes his scalpel to within a quarter of an inch of the point, by wrapping it with lint, and directs it in such a manner as not to bury the instrument in the gland, but passes it along the internal surface, he can, by a few repeated touches of this kind, succeed in evacuating the abscess, without incurring any danger of hæmorrhage.

Sometimes bleeding follows this operation, though performed in the most careful way ; this need not alarm the operator, as it arises from the tonsilitic artery being opened, which almost invariably ceases after the lapse of a few seconds ; if it continues, so as to be of any annoyance, it can be arrested by the application of an astringent.

Observation. In general the enlargement of the amydalæ in the adult is of a simple nature, and produces inconvenience rather than disease : but in infants and very young children, much more serious effects arise from it. Besides the alteration in the voice, the swelling is so considerable as to close up the Eustachian tube, and produces deafness ; the respiration is noisy and rattling during sleep : a very remarkable feature in this disease in subjects of the age we are now considering, is an almost constant coincidence between it and mal-formation of the thorax, which is rounded and arched posteriorly, contracted anteriorly, and flattened at the sides.

To the powerful and continued action of the respiratory muscles, to overcome the obstacles which are opposed to the entrance of the air into the lungs is this deformity in all probability due, so invariable are these phenomena, that they may be considered in the relation of cause and effect.* This state of the amydalæ call for the operation more imperiously than in the adult, and does not present any additional anatomical danger.

Excision of the Uvula. This portion of the soft palate, is often permanently enlarged and elongated, from repeated attacks of inflammation; it hangs into the fauces, causing great irritation, frequent cough, and inclination to vomit.

Operation. To relieve this inconvenience, the surgeon seizes the uvula with a polypus forceps, and brings it forward into the mouth, and snips whatever portion he intends removing, with a scissors: it is very seldom that hæmorrhage supervenes after the operation; however, should it occur, it can be arrested by any active astringent.

The fear of hæmorrhage induced the older surgeons to remove the enlarged part of this body with a ligature; in plate xxi of *Heister's Surgery*, will be found, at fig. 6, 7, 8, representations of various instruments for this purpose.

Extirpation of part of the Tongue. Cancer is the affection which most frequently requires this operation; it may be situated at the tip, side, or

* Med. Oper. par Sabatier, tom. iii.

base of the organ: the two former are those situations in which it is alone considered advisable, by prudent surgeons, to undertake the removal by operation.

Operation. When the disease is situated at the tip of the tongue, the patient is to protrude it from the mouth, to enable the surgeon to seize it between the thumb and index finger of the left hand, who includes the disease in a \vee shaped incision, made with a strong-bladed scissors; the lips of the wound are then to be united, and maintained in apposition, by one, two, or more points of suture.

Clean incised wounds of this organ, unite in a very short period.

As the disease is more frequently situated at the side than tip of the tongue, where it cannot with safety be extirpated with the knife or scissors, surgeons are compelled to resort to the ligature, which is to be applied as follows;—having armed a strong, curved, and sharp-pointed needle with a double full-sized ligature, the patient is to protrude the tongue as far as possible; the surgeon having exactly ascertained the extent of the disease, forces the needle through the sound part of it, from below upwards, and as soon as the ligatures appear at the dorsum of the organ, he draws them out of the mouth, and arranges them in such a manner as that one will bound the anterior part, while the other will circumscribe the posterior portion of the disease: the ligatures are

then tied with a sufficient degree of tightness to prevent the flow of blood, also to induce mortification and ulcerative absorption ; in a short time the disease will slough out.*

Extirpation of the parotid Gland. That this gland has been extirpated (I may almost say completely), is evidenced from the writings of Heister, who distinctly speaks of the difficulty of the operation, and the alarming hæmorrhage that invariably attends it. "Here-upon the blood rushes forth so impetuously, that near a pound will be lost before the surgeon can lay down his knife, and apply the dressings." He further remarks that the patient on being put to bed, an assistant ought to sit by the bed-side, and firmly compress the dressings on the wound for several hours with his hands, the more effectually to restrain the hæmorrhage ; after which the patient should keep his bed quietly for three or four days, without removing the dressings, for fear of a fresh hæmorrhage.†

That such an operation should not be engaged in, on trifling grounds, and without able and tried assistants, the histories of the various attempts to remove the gland furnish convincing proofs ; the anatomical relations of the parotid

* Home on Cancer, for successful cases of this kind.

† Heister, p. 476 ; he quotes Roonhuyer and Tilingius, who extirpated it prior to 1693.

also testify the dangers the operator will encounter, who undertakes it.

The best authenticated cases of what may be considered the total removal of the parotid, are those by Mr. Carmichael * and the late Professor Blecard.† In the note at the foot of the page will be found the particulars of their cases.

* Transactions King and Queen's Coll. Physicians for 1818, vol. ii. p. 101.

† Archives Generales, Tom. iv. p. 62, 1824.

In Mr. Carmichael's case, the tumour was of some years duration, attempts had been made by himself to remove it with arsenical applications ; these failed to relieve the disease ; it increased, and at the time of the operation being performed, the dimensions were five inches from the root of the ear vertically, three and a half inches horizontally below the ear, and five inches at the inferior part.

He made one incision for the length of the tumour, which was extended along the neck over the external carotid, to allow of securing this vessel if necessary ; the deeper portions of the mass were sliced away, in effecting which, a large vessel was opened, from which blood issued in a furious stream, it was secured ; the entire of the gland was finally removed, but a small portion attached to the base of the skull, which was included in a ligature, and in some days sloughed off : the portio dura was divided ; paralysis of that side of the face followed ; which was considerably relieved five months after the operation.

He (Mr. Carmichael) advocates the necessity of a safety ligature.

This gland has been also extirpated by M. Beclard, who circumscribed the disease by two semilunar incisions, and dissected the part of the tumour that lay upon the masseter muscle, from before behind. It was then attempted to detach the tumour from above downwards, but was found impracticable from a large process that dived posterior to the internal pterygoid muscle ; it was consequently abandoned, and the trial made in the contrary di-

For the extirpation of tumours of this kind, and such as are connected with the large blood-vessels and nerves, no defined rules can be laid down, since the line of the incisions will depend on the form and size of the tumour; the operator

rection; the cartilaginous tube of the ear being implicated in the disease, was removed; when extirpating the posterior portion of the gland, a part of the sterno-mastoid muscle was also cut away. While occupied in taking away the process of the gland that passed behind the lower jaw, which was done by slicing it, a gush of blood, announced either the opening of the external carotid, or several of its large branches; the haemorrhage was arrested by compressing the wound with the finger; the vessel was seized with a forceps, and a double ligature conveyed under it, and tied on each side of the opening. All the tumour was finally taken away but a small part, situated anterior to the cervical vertebræ, which was included in a ligature, as its vicinity to the internal jugular vein forbade the use of the knife.

The sequelæ of this case were not as favourable as those of Mr. Carmichael's; the patient suffered much from erysipelatous inflammation, and occasional delirium; the muscles on that side of the face were paralysed; the eye-lids constantly open, and chronic ophthalmia supervened in the eye of that side; during the sanative processes he became deaf, probably in consequence of inflammation extending from the site of the tumour into the ear: he ultimately was afflicted with taciturnity, and mental alienation. He died about three months after the operation, with all the wound cicatrized but in one spot near the ear, which was assuming the cancerous appearance: the affection for which the operation was performed.

The autopsy exhibited the pia mater injected with blood; some water in the ventricles, and pus in the external auditory canal, while the tympanal cavity of the ear on that side was uninjured: the external carotid artery was converted into cellular membrane, and the internal jugular vein was obliterated in the same place.

will best attain his object by a perfect knowledge of the anatomy of the region concerned in the operation, and by attending to the example of that experienced surgeon, M. Langenbeck of Berlin, who adopts the following plan : after the patient is properly placed, he makes a free division of the integuments, and dissects the muscles from the tumour, without cutting them. In this manner the mass is rendered more moveable : by the position of the muscles, he is enabled to know the situation of the blood-vessels and nerves, as he can satisfy himself of what parts are related to either of the edges, or their under surface ; hence he is not in danger of wounding unintentionally any important vessel : after the surface of the tumour has been cleared, he commences the separation on that side, which presents least danger to important parts, and passes thence towards those which, if possible, must not be wounded ; this surgeon never introduces his knife deep into the wound, but draws the tumour out of it, and cuts the cellular membrane thus rendered tense, by which means the swelling is removed more and more from the vessels : consequently it is more safely detached, while these are better protected.

Anatomy of the parotid Gland. This organ is of a pyramidal shape, and offers an external surface ; an anterior and internal one ; also a posterior and internal surface ; from the two last numerous processes are sent inwards, and hold very important relations. The external

surface is slightly convex, and extends from the zygomatic arch of the temporal bone, as low as the angle of the inferior maxilla, sometimes a little lower; this side of the parotid is covered by the skin, a dense prolongation of the cervical fascia, and by a few fibres of the platysma myoides; the covering of the cervical fascia exerts considerable influence over the progress of abscesses when seated in the parotid; it is so firm, that it completely prevents their coming directly to the surface, which renders it imperative on the surgeon to open such collections with the knife; if he is timid and will not give exit to the matter, in some time it will make its way outwards through the external auditory canal, by means of the slits situated in the inferior surface of the cartilaginous tube of the ear. The anterior and internal surface rests upon the posterior part of the masseter muscle, and a portion of the ascending ramus of the jaw. The posterior internal surface covers a part of the insertion of the sterno-mastoid muscle and process, also of the posterior belly of the digastric m. The gland from these two sides penetrates deeply by a number of processes, viz.—anteriorly, one passes behind the neck of the inferior maxilla, and accompanies the internal maxillary artery, for a part of its course, touching the internal pterygoid m.; a second dips into the posterior part of the glenoid cavity, and is in intimate contact with the cartilaginous tube of the ear, occasionally with the corda tympani, as it escapes through the Glasserian fissure; posterior to these, a third portion dives as far as the styloid process, and is consequently in juxta-position with the muscles attached to it, this part of the gland often bifurcates; one portion passes anterior to the styloid prolongation, and rests on the internal

carotid artery, while the second penetrates posterior to it, being placed in relation to the digastric m. and the internal jugular vein; if the gland is large, the prolongations which go so deep as the internal carotid artery and internal jugular vein, often send slips to the back of the pharynx, and even to the basilar portion of the occipital bone.

The external carotid artery courses through the parotid g., and gives off the posterior auris, (sometimes the occipital, as it enters its substance,) the internal maxillary, the transversalis faciei, and terminates in the superficial temporal; besides these vessels, numerous twigs are distributed to the gland from these sources. The principal branches of veins that form the external jugular descend through the gland. A number of nerves are related to this organ, e. g. the portio dura, or facial respiratory of Bell, runs through it, filaments from the cervical plexus, as the auricular, pass along the external surface; while the deep processes of the gland are in contact with the component parts of the eighth pair, and with the ninth pair of nerves, also with the superior ganglion of the great sympathetic. The duct passes out from the anterior internal surface, crosses the masseter m., and penetrates through the cheek into the mouth.

Extirpation of the Mamma. This operation is resorted to, under two very different conditions; in the one, the affection is not reputed of a malignant character, and the gland is removed in consequence of the inconvenience the patient suffers from it, such as in the hydrated enlargement of the breast, in chronic mammary tumours, also in cartilaginous and ossific deposits, and

sometimes in large adipose tumours; whilst in the other affections, the disease is decidedly malignant, as in cancer, and the fungous tubercle.*

The subject of the operation may recline upon a table, or be seated on a chair, with the shoulders drawn back as much as possible, and retained in that position by an assistant; the operator either sits or stands before the female, and having made the integuments tense, by drawing the skin downwards, while an assistant raises the breast, he makes a semi-elliptical incision on the inferior and external side of the tumour, some distance from it, and in the decidedly healthy skin; in a similar way he incises on the opposite side of the breast, the integuments being previously rendered tense: as no danger is present of opening large vessels, the incisions ought to be made with rapidity, and penetrate freely through the superficial structures; they should also run, as parallel as possible, to the fibres of the pectoralis major, which will facilitate the subsequent dissection.

The operator now proceeds to detach the tumour from the subjacent parts, also from below upwards, in the course of the fibres of the great pectoral muscle, being attentive not to raise any part of it, which allows the blood that is shed during the operation to flow from the wound, thereby preventing its lodging, and concealing the parts that are to be divided.

* Diseases of the Breast—Sir A. Cooper, London, 1829.

After the diseased mass is removed in the living subject, the surgeon must sedulously examine if any morbid parts remain, which in most instances are indicated by an alteration in colour of the muscular structure, being changed from the florid red, to a tawny appearance; the fibrous character is also less evident than in the healthy condition: if any white fibrous bands radiate into the neighbouring cellular membrane, it is admitted by every practical surgeon, that the disease cannot with any degree of certainty, be said to be completely removed: it is the great tendency of the disease to spread into the surrounding parts, that inculcates the necessity for making the incisions into the healthy parts more extensive, than at first appears absolutely necessary, in order that the whole of the diseased mass be to a certainty taken away: if any glands in the axilla are enlarged, it will be most prudent to remove them; the manner of proceeding will be found at page 37.

The wound is next to be sponged, the arteries secured, and the parts brought into as close apposition as possible; which is facilitated by the arm being placed next the thorax, when the lips of the wound can be retained *in situ* by adhesive plaster, unless a considerable quantity of integuments have been cut away.

Excision of the Clitoris. Enlargements of this organ, and cancerous affections, are what induce the practitioner to perform the operation.

The patient being situated as in lithotomy, the operator divaricates the labia pudendi, so as to obtain a precise view of the diseased mass, and seizes it either with his fingers or a hook, when he can remove it with a scalpel, or a curved scissors ; seldom hæmorrhage of any amount follows the operation. Should it occur, the arteries of the corpus spongiosum being tied will arrest it.

A T bandage will then be required to support the dressings.*

Enlarged Nymphæ. The nymphæ are sometimes so large as to hang beyond the labia pudendi, and may prove troublesome to the female in walking and in sitting ; they therefore require the surgeon's assistance ; who will place her in a proper position, separate the labia, and remove the exuberant portion either with the scissors or the knife ; seldom a ligature is required to restrain the hæmorrhage.†

* A few weeks ago my friend Mr. Auchinleck extirpated an enormous Clitoris, which weighed five pounds and some ounces imperial ; the removal of it was accomplished with his usual dexterity and precision ; two ligatures were only used, one for each artery of the corpus spongiosum.

The growth and character of this affection is so peculiar, as to render the publication of the case, in detail, a matter of necessity ; it is hoped that he will not defer giving it to the Profession ; one half of this mass has been presented to my Anatomical Cabinet, by that gentleman, to whom I am also indebted for numerous other interesting specimens of Pathology, and the other to the Museum of the College of Surgeons.

† Heister, chap. cxlviii and ix.

Excision of the neck of the Uterus. Germany, so fertile in the Cæsarian section, has led the way in extirpating the neck of the uterus, to which has succeeded the imprudent trials of removing the uterus itself. Cancer of the os tincæ is the principal, perhaps the only affection that requires its excision. Osiander of Göttingen was the first who attempted the removal of this portion of the uterus.

Manner of performing the operation. The patient being situated as in lithotomy, *per vaginam*, a speculum is to be introduced into that canal; after the parts are examined, the surgeon seizes on the neck of the uterus with a double hook, and draws it gently down into the vagina; then with a scalpel, or what is better, with a scissors curved on the flat, he cuts away the diseased portion of the cervix uteri, freely from the sound parts. The hæmorrhage that follows this operation is never of any account.

Extirpation of the Uterus. This formidable operation has been chiefly insisted on by Doctor Blundell, on the part of British practitioners, and by Doctors Recamier and Roux, on that of the French, in cases of cancer of this organ.

The practice of these gentlemen permits us to form two plans for the operation.

First plan. Dr. Blundell divides the operation into four periods:—*first stage*, the patient being secured as for lithotomy, and the knees divaricated, the first and second fingers of the left

hand were passed into the vagina, the index finger being converted into a kind of cutting instrument, by means of a knife of a particular construction, which was mounted on a long slender shank, both included being about eleven inches long; the blade was attached to the handle, in such a manner as that its flat or plane surface formed with it an angle of 15 or 20 deg. This knife could be protruded beyond the fingers to act its part in the operation; or be withdrawn so as to place the point of it within the fingers, to protect the surrounding parts from injury. By alternately exploring with the index finger of the left hand, and cutting with the apex of this knife, the operator gradually worked his way through the back of the vagina, towards the front of the rectum, so as to enter the recto-vaginal portion of the peritoneal cavity; minute care was requisite in this part of the operation, to avoid wounding the intestine. *Second stage.* The small opening formed in the back of the vagina was gradually enlarged by introducing the first joint of the index finger, a little by dilatation, and a little by laceration. The next object with the operator was to enlarge this aperture transversely, from side to side; which was effected by the knife already mentioned being passed into the opening, and carried on each side as far as the broad ligaments of the uterus: the diseased and healthy portions of the vagina were thus detached from each other by this transverse

incision, which stretched across the vagina, between the roots of the broad ligaments immediately below the diseased parts. At this time the intestines could be felt hanging about the tips of the fingers; but the blade of the scalpel lying on the finger, in which it was as it were imbedded, the risk of the wound, whether by point or edge, was completely prevented. *Third stage*, consisted in passing the left hand into the vagina, which was accomplished with little difficulty, as the woman had borne children; afterwards the first and second fingers were entered through the transverse fissure along the back of the uterus: the intention then was to seize the fundus of the womb, which was partly effected by a hook, and partly by the fingers already introduced into the abdominal cavity, through the transverse incision; by a little manœuvring this was attained; and the fundus of the uterus, by a movement of retroversion, was brought downwards and backwards into the palm of the left hand, then lodging in the vagina; at this part of the operation the diseased mass might be seen placed just within the genital fissure. *Fourth stage*. The diseased structure still in the palm of the hand, remained connected with the sides of the pelvis, by means of the fallopian tubes, and broad ligaments; with the bladder, by means of the peritoneum; and with the front of the vagina, by cellular membrane.

The broad ligaments were then cut through,

close to the sides of the uterus; and in dividing the vagina great care was taken to keep clear of the bladder and the ureters. The section of these parts, and the removal of the diseased mass, constituted the fourth step of the operation.*

Second plan. The operation, as performed by M. Recamier, differed but in a few particulars from that of Dr. Blundell, *e. g.* he seized the uterus close to the cervix, with a "forceps de museux," the blades being curved to form each a right angle, and drew it down to the external aperture; the forceps thus armed was given in charge to an assistant, who retained it in this position: having ascertained that the rectum did not descend with the uterus, the operator passed the index finger of the left hand, between the prolapsed uterus and vagina, on which he conducted a knife, having only a convex cutting extremity, the sides being blunt, and made an incision about one inch in length, directing the edge towards the uterus, so as to protect the bladder. The knife was then withdrawn, and the incision enlarged by means of the finger, separating the connexions between the vagina and neck of the uterus with the bladder; the reflection of peritoneum which passes from the bladder to the uterus, was then divided with the knife first used, and the incision extended right and left with a blunt-

* Letter from the operator, Dr. Blundell, to the Editor of the Lancet, vol. iii. 1827-8, p. 598.

pointed bistoury. The anterior surface of the uterus, and the broad ligaments which were in a tense state, from the dragging down of the uterus, could be now reached by the forefinger; when the edge of each ligament was divided close to the uterus, till only a third of the thickness remained uncut: the knife was now laid aside, and a ligature conveyed round the undivided part of each ligament, and tied. The index finger was then passed over the uterus, to its posterior surface, which was brought forward, and the fundus downward through the incision, into the vagina. The bistoury was then conveyed along the finger, to divide the peritoneum as it passes from the uterus to the rectum, to dissect the cellular connexions between these parts, to divide the posterior surface of the vagina, and to complete the section of the broad ligaments. During the separation of the uterus from the rectum, an assistant kept his finger in the intestine, and gave notice of the operator's progress. The uterus having no longer any attachment in the pelvis, was easily withdrawn and removed. Of the vagina two inches in length were cut away from its anterior parietes, and two and a quarter inches from the posterior wall.

At the period of the removal of the diseased parts, the extremity of the omentum appeared between the nymphæ, and was immediately replaced.*

* Archives Gen. de Medecine, Sept. 1829, tom. xxi. p. 78.

Observations. This operation (experiment) has been introduced into the text, more to satisfy the reader as to the actual attempts and state of operative surgery up to the present time, than from any conviction upon the author's mind, that such a proceeding could ever be considered in an eligible point of view, or that it could ever be countenanced by the most experienced men in the profession; neither that it can ever be regarded as a legitimate part of operative surgery.

What does the great British advocate for the extirpation of the uterus say, as to the difficulties and dangers of this operation, "the principal dangers consist in a risk of haemorrhage; a risk of narcotic shock produced by the removal of the parts; a risk of the protrusion of the intestines; a risk of wounding parts contiguous to the uterus, as the ureters, the bladder, the rectum, the folds of the small intestines :" he has omitted to mention the almost certainty of peritonitis ensuing after such an operation. It is conceived by him, that a skilful operator may avoid wounding parts of importance,* the protrusion of the intestines he considers seldom to occur,† and states, that in no instance has haemorrhage caused death; however, sufficient blood has been shed during,‡ and after the operation,§ to augment considerably what Dr. Blundell acknowledges to be the principal danger of it, namely, the shock inflicted upon the nervous system, which seems nearly allied to those collapses that arise from other injuries of large or important parts of the

* In M. Recamier's second case the bladder was wounded.

† In M. Recamier's first case the omentum protruded.

‡ Mr. Roux, second operation.

§ Mr. Banner's case; and M. Recamier's second attempt.

body; as laceration of the uterus, rupture of the stomach or bowels, blows upon the head, or the like; and although those shocks seem inseparable from the operation, much, perhaps, may be done to diminish them.* For the candour displayed by Dr. Blundell, in stating both the favourable and unfavourable bearings of this operation, his trials of it, and their failures in all but one instance, (see note,) he is highly deserving of the respect of the profession, and affords an example worthy of imitation; as few are found to acknowledge their unsuccessful practice in the same frank and honourable manner, which he has shewn on this occasion.

If nothing but the severe nervous impression produced upon the system by the operation should interdict it, that alone, in my opinion is sufficient; the prudence of that surgeon cannot in future be admired, who undertakes an operation, that will almost inevitably be productive of such an effect upon the nervous system, which is so much beyond his control, and which is powerfully increased, when we reflect that the subject of the experiment has been, for a length of time, suffering from both physical and mental anguish, of the most distressing character, and resigns herself to a forlorn hope, in expectation of a mitigation of her pain, and continuance of life.

If cancer maintains the same character, when it affects the uterus, as it does in other situations, and I see no reason to question it; it is an additional argument against the extirpation of this organ: as from the late period the operation will be engaged in, being the sole

* Dr. Blundell's Lect. xxv., as reported in the *Lancet*, vol. ii. p. 615, 1828-9.

and ultimum remedium that can be offered to the afflicted patient; the chances, nay, the certainties, are, that other tissues are implicated in the disease which cannot be taken away, (see the autopsy of Dr. Blundell's case in the note,) consequently rendering the attempt altogether unjustifiable, even in the estimation of the most experimental operator.

The dangers of the operation have been so fully described by Dr. Blundell, that nothing more can be added to them.

This experiment has been now so fairly tested,* and failed, that I hope very little probability exists of its

* By M. Wolff.—The patient lived between thirty to forty hours after it.—*Lancet*, vol. ix. p. 171, 1825-6. By Dr. Siebold of Berlin.—The patient died sixty-five hours after the operation. It is but fair to add, that the operation ought not to have been undertaken in this case. By Dr. Holscher, also of Berlin.—The patient expired twenty-four hours after it.—*Johnson's Med. Chir. Review*, vol. iii. p. 264, 1825.

Dr. Blundell performed the operation four times; one survived for a year, dying in consequence of constipation of the bowels. On dissection, the rectum was found considerably contracted about four inches above the anus, and its course unusually tortuous: the situation of the uterus was covered over by the bladder, the ovaries, and the divided ends of the broad ligaments: in various parts of the pelvis, carcinomatous and cerebriform tumours were found. Of the remaining three, one died two or three hours after the operation; the second in the course of four or five hours; while the third survived the extraction of the uterus thirty-nine hours.

In Mr. Banner's (Liverpool) case, two clots of blood, each amounting to eight ounces, were discharged soon after the operation. The patient suffered from pain of the abdomen, constant vomiting, and lived till the fifth day. Autopsy—exhibited inflammation of the omentum and intestines.

being repeated by either the present or succeeding generation of surgeons.

The records of our profession, prove that intrepidity is the characteristic of British surgery, which has been always chastened by sound judgment and discretion, invariably tendering to afflicted humanity, on well-established physiological and pathological inferences, *the healthy prolongation of life*, in return for the fortitude and patience exhibited under surgical operations.

In no instance is extirpation of the uterus justified,

M. Recamier's case recovered. Archives Gen. de Medecine, Sept. 1829, p. 78, tom. xxi.

Mr. Roux has operated twice—the first patient sunk in thirty three hours; the second died in twenty-four hours. Bulletins des Sciences Med. Oct. 1829.

M. Recamier, emboldened by his success, has attempted the removal of the uterus twice since last year (1829); in one he succeeded, but the patient died in thirty-three hours ;—a short time after the operation, smart haemorrhage occurred ; the dissection indicated the left uterine artery to be open, which gave rise to the bleeding, and a small foramen “pertuis” into the bladder was detected. In the second attempt the uterus was so soft that the forceps could not hold it. A third operation was undertaken under the inspection of Dr. Recamier, by Dr. Dubled, upon a new principle ; and the patient died in twenty-two hours. The necropsy presented nothing interesting. In the Archives Gen. de Med. tom. xxiii. p. 403, (July 1830,) which contains the details of the three last operations, it is announced, that M. Recamier's first case died about eleven months after the extirpation of the uterus. During the time that intervened between these two periods, she suffered much from incontinence of urine, and diarrhoea. Strange to say no *post mortem* examination was instituted. Is the energy, zeal, industry, and example of Laennec becoming extinguished amongst the Parisian Professors ?

but in cases of prolapsus or inversion of it, of very long standing.

Excision of the Prepuce in Phymosis. This affection may be congenital or accidental, simple or complicated. The congenital species requires the operation in consequence of the impediment to the passage of urine; still those who suffer from such malformation, seldom are much annoyed by it, till puberty; when the erections of the penis produce considerable pain, and the venereal act is imperfectly performed; while the partial retention of the semen and sebaceous secretion often cause spurious gonorrhœa; this malformation is also considered as the exciting cause of cancer of the glans penis. (*Hey.*)

The surgeon can avail himself of one of two plans for performing the operation; the first is by circumcision, and is so simple that scarcely any direction is necessary for it; it is particularly applicable to the congenital kind:—after the ring of skin is removed, the surgeon ought to divide the internal or mucous membrane of the prepuce for half an inch or so in the direction of the frenum, which will free the glans, at the same time leaving a partial covering for it. The second plan may be effected by passing a bistoury between the glans and prepuce, as far back as the corona glandis, when the point is to be forced through the integuments, and drawn towards the surgeon, so as to divide whatever is presented to its edge.

The last proceeding ought to be resigned in favour of the first, or to that which succeeds, as the patient, after the cicatrization of the wound, will be much annoyed by a large pendulous flap of skin, hanging on each side of the penis, the remains of the prepuce.

M. Cloquet advocates the following operation, which obviates the pendulous flap, and prevents deformity:—in place of dividing the superior portion of the prepuce, he passes the bistoury between the glans and frenum, and cuts as much of the prepuce, in that situation, as is necessary to denude the glans freely. This plan I have adopted on one occasion, and derived much satisfaction from the very little deformity that resulted after it.

The complicated phymosis, or that dependent on disease, is to be relieved by any of the preceding methods, and will afford relief to the patient by operating at an early period of the affection.

Amputation of the Penis. Cancerous affections of the organ are those which compel the patient to submit to this operation: it is worthy of remark, that every case is preceded by congenital phymosis; that accurate observer, Mr. Hey, was the first to notice this fact, which has been corroborated by all succeeding practitioners.

As the prepuce cannot be retracted to examine the glans, it will be necessary to slit it open, as in phymosis, when a full view of the diseased mass will be obtained, and the operation accom-

plished as follows :—the surgeon holds the penis with the left hand, and draws the skin as far forward as is possible ; then, with one sweep of a scalpel he divides all the parts that constitute the organ. It may be necessary to secure the dorsalis penis artery, and those of the corpora cavernosa.

Before dressing the stump a full sized bougie ought to be introduced into the urethra ; if this precaution is neglected, the urethra and skin, during cicatrization, have so powerful a tendency to contract, that the orifice will be completely closed, and an insurmountable barrier to the exit of urine will be formed.

Extirpation of the Testicle. Cancerous affections, fungous haemato-des, severe accidents causing the rupture of the testicle, and those cases denominated the irritable testicle,* are the affections which generally induce the removal of this organ.

In malignant affections, prior to the operation being resorted to, it will be expedient to ascertain if the cord is healthy ; if it is knotty, hard, and painful, and the pain extends along it upwards to the loins, the operation is generally contra-indicated, particularly if the patient presents the symptoms of a broken-down constitution.

Operation. The patient is to recline on a table,

* Cooper's Lectures, by Tyrrell, vol. ii.

with the legs hanging over the edge, while the surgeon stands between them, the hair of the pubes being previously removed; if the tumour is small and not adherent to the skin, he makes a simple linear incision, from a little above the abdominal ring to the fundus of the scrotum, which is sufficient to expose the diseased organ; on the contrary, should the integuments adhere to the testicle, and it present any magnitude, two semi-elliptical incisions are necessary to circumscribe the disease, and should extend from a little above the abdominal ring to the fundus of the scrotum, by which the formation of a cul de sac is prevented, where matter might lodge; by prolonging the incisions above the ring, the cord will be more easily dissected from its adhesions. The cord is next to be freely exposed by a careful dissection, but not completely insulated from the surrounding parts; if it appears larger than usual, and presents a yielding sensation, it will be proper to examine if any omentum, or intestine, has penetrated into the sheath; if this should be the case, it must be returned into the abdomen, and retained by an assistant: the surgeon next either passes a ligature through or under the cord, and ties it, to prevent its retracting within the inguinal canal when cut across, and proceeds to remove the testicle by dissection, which is a simple thing, provided no firm adhesions exist; but if these are present, a cautious dissection is necessary, so as not to open the urethra, or to pene-

trate the septum scroti and tunica vaginalis, of the sound side; as the gland, if much enlarged, will be in intimate contact with these parts. The testicle being removed, the cord is then to be examined for the spermatic artery, which will be found at the anterior part of it, also a small one accompanying the vas deferens; the septum scroti next claims the operator's attention, who secures any bleeding vessel that offers; he should not alone be content with a superficial examination, but carefully search for vessels in this part of the wound, as often a very unpleasant haemorrhage proceeds from these neglected vessels, a few hours after the operation.

The ligature that had been passed through the cord at the commencement of the operation, is then to be removed, and the lips of the wound united by two or three points of fine suture.

Observations. M. Roux, though a great supporter of union by the first intention, after many operations, condemns it, in this particular instance, and observes, that he has never seen the attempt succeed; he further remarks, that he has made parallels between this species of union, and cicatrization derived from suppuration and granulation, to ascertain which method will most speedily produce union, and decides in favour of the latter; since he conceives that suppuration cannot be prevented, in consequence of the haemorrhage that invariably ensues, from the small vessels of the lax cellular membrane of the scrotum: being of opinion, that the blood will not be absorbed, the suppurative process must consequently be

excited to discharge it. Acting from such an opinion the Surgeon of La Charité advises dressing the wound with charpie, and to seek for union by suppuration and granulation.* It appears to me that the haemorrhage of which M. Roux speaks, can be prevented by well directed pressure; and though all the wound may not unite in the manner wished for, still some portion of it will heal by the first intention, and so abridge the period of confinement.

The most particular step in this operation, is the management of the spermatic cord, so as to prevent haemorrhage, which is more necessary if it be enlarged near the ring; in such cases the most efficacious means to guard against bleeding, is to divide it gradually, and secure each vessel as it bleeds; this may be considered tedious; but it is the most secure plan to prevent haemorrhage from the cord.

It has been proposed to simplify the operation of castration, by producing atrophy of the testicle, by merely making an incision to expose the cord, then secure the blood vessels, and cut it across. M. Maunoir, of Geneva, has suggested and acted up to this plan, but was unsuccessful.

A very easy and expeditious plan may be adopted to extirpate the testicle, provided it is not adherent to the surrounding parts; it consists in seizing the scrotum, posteriorly, to make the testicle press against the anterior part of it, and project, then to cut boldly upon it, when the gland will start from the wound: the operation is to be completed as already described.

* Roux Relation d'une Voyage faite à Londres en 1814.

CHAPTER VIII.

EXTRACTION OF FOREIGN BODIES FROM THE PHARYNX.—OPERATIONS OF OESOPHAGOTOMY, LARYNGOTOMY, AND TRACHEOTOMY.

WHEN a body is impacted in the pharynx, the surgeon will, in most cases, be able to extract it with his fingers, for which purpose he places the patient sitting on a chair, with the head thrown far back, and supported by an assistant; when the mouth being opened, he depresses the root of the tongue with the forefinger of the left hand, and introduces the thumb and index finger of the right hand into the fauces, to take hold of the extraneous substance; which, if not at too great a depth, he will be able to bring away. In such an accident as this, the surgeon should not hesitate to pass his fingers as deep as possible into the fauces. I feel satisfied, on one occasion, by acting in this way I prevented the substance entering into the trachea. But in cases where it is placed beyond the reach of the fingers, if a long narrow polypus forceps, with the blades closed, so as to allow it at first to be used

as a species of sound, be introduced along the back of the pharynx, to avoid injuring the epiglottis, and opened after the position of the foreign substance has been ascertained, it may by this means be seized and extracted with little difficulty. Pieces of sponge fastened to ligatures, and other means, have been resorted to for the same purpose, which have been oftentimes crowned with success.*

When these measures are inapplicable, it will be necessary to have recourse to the probang, and endeavour to protrude the foreign body into the stomach ; in the attempt to dis-

* A successful case is given by Dr. Cleghorn in the Med. Observations and Inquiries, vol. iii. p. 7, of a girl suffering under insanity, who swallowed a goose quill ; a piece of sponge was passed into the œsophagus, so as to entangle it in the feathered part of the quill, by which means he was able, after a little trouble, to remove it.

Also, in the Revue Medicale, July 1830, p. 90, is given a case of the extraction of a five franc piece, from the inferior part of the pharynx, where it had been lodged for twenty-four hours, and projected into the neck : various means were tried to remove it, as vomiting, the forceps, &c. &c. ; these failed : the extraction was accomplished by the use of a long flexible piece of whalebone, terminated at one extremity by a piece of silver of a conical shape, six lines wide, and of similar depth ; it was capable of slight lateral motion on the whalebone. This instrument was introduced into the pharynx, and passed between it and the five franc coin, penetrating below it ; the base of the piece of silver was excavated for the occasion ; on being withdrawn, it fortunately hitched in the piece of money, and enabled the surgeon to extract it.

lodge it with this instrument too much force ought not to be applied, as there is some danger of driving it through the sides of the œsophagus, or injuring that tube in a very serious manner. Previous to the probang being introduced into the mouth, it will be expedient to moisten the sponge which is at the end of it with a little water, and direct the patient to open his mouth, at the same time to throw back his head as much as possible, that the cavities of the mouth, fauces, pharynx, and œsophagus, may run in a continued straight line ; the instrument being curved by drawing the cord which is connected with the sponge, is to be passed into the mouth, and carried quickly across the isthmus faucium down into the tube, until it is arrested by the foreign body, when it is to be pressed with some degree of firmness against it : should the body not yield to a gentle pressure, great caution is requisite, when increasing the force, or, in all probability, a false passage may be made, and the case rendered worse ; if the extraneous substance cannot be dislodged by moderate force, it will be safer to desist, and have recourse to the operation of cutting down on the œsophagus to remove it.

Œsophagotomy.—Some surgeons, from unwarrantable timidity, may be inclined to allow an extraneous substance to remain, where it is lodged in the œsophagus, confiding too much in the efforts of nature to get rid of it; the history of such cases fully prove the bad consequence

of such delay, as it is shewn, that in almost every instance where this practice has been followed, the result was fatal. Guattani gives a case of a man playing with boiled chesnuts, one of which fell into his pharynx; however, he spoke and breathed easily, but suffered much inconvenience about the lower part of the neck. The surgeons who saw him could not believe that he had swallowed any of them; the man survived the accident nineteen days: at the *post mortem* examination, a collection of matter was found situated between the œsophagus and trachea, and a small opening communicating with the latter tube, that admitted the matter into it, the chesnut was seen closely embraced by the œsophagus. After witnessing this case, Guattani proposed laying open this tube in the human subject, and made some experiments on dogs, to prove what little inconvenience they suffered when their œsophagus was laid open.

The injurious effects from the presence of foreign bodies in the œsophagus, are not only impediments to deglutition and to respiration; but if allowed to remain in it, inflammation in the tube will be induced, and purulent collections form; which may open into the trachea, and admit whatever is swallowed, to be conveyed into it, at least in part, which produces so great a degree of irritation, as is sufficient in a short time to terminate in death.

Operation. First plan. Before the operation

is commenced, it will be expedient to ascertain the exact situation of the foreign body, by sounding the œsophagus with a gum elastic catheter, which will pass through the tube, till it meets with the extraneous substance, when the operation, as described by Vacca Berlinghieri, may be performed. The patient being seated in a chair, with the head thrown back, a gum elastic tube, open at both ends, and armed with an elastic steel stilette slightly curved, and split longitudinally to some distance from the end that is to pass into the œsophagus, thus consisting of two parts ; to each of which is attached a semi-olive shaped tubercle, which form an oval body when they are maintained in contact by drawing them by means of the stilette, close to the catheter ; this instrument will answer all the purposes of an exploring sound, and is to be kept close to the foreign body, after it is introduced into the œsophagus. An incision is then made for two and a half, or three inches in extent, along the left side of the neck on that part occupied by the foreign body, and the dissection continued until the œsophagus is nearly exposed, after which the gum elastic tube is to be withdrawn with one hand, while the stilette, with the oval-shaped termination, is maintained in contact with the foreign body, the branches of it will then diverge, which causes the two semi-oval tubercles to separate and elevate the sides of the œsophagus, serving as guides to the surgeon,

who is to open the tube and remove the substance.

This operation is rendered complex, by introducing an instrument into the œsophagus, for the purpose of dilating it; will not the situation of the foreign body indicate itself as soon as this duct is exposed? Without resorting to such a proceeding, the œsophagus may with facility and safety be laid bare in any part of its course above the thorax, by the following method, which I have often verified on the dead subject. The situation of whatever obstructs the œsophagus may be ascertained by examining it with a gum elastic catheter; the left side of the neck is to be selected in preference to the right, for reasons which will be immediately mentioned; however, if the foreign substance decidedly projects to the right, it will be advisable to perform the operation on that side.

Second plan. An incision, from two to three inches long, is to be made parallel to the anterior edge of the sterno mastoid muscle, opposite to the spot where the body is lodged, through the skin, platisma myoïdes and cervical fascia; the mastoid muscle being exposed, is to be drawn outwards; and the dissection prosecuted by cutting the deep cervical fascia to the same extent as the integuments, a director being introduced under it to protect the subjacent parts, when the sheath of the carotid artery and internal jugular vein will be exposed, which is to be

protected by the assistant, who has charge of the sterno-mastoid muscle; if the sterno-hyoid and thyroid muscles are in the way they are to be drawn to the inner or tracheal side of the wound, when the œsophagus will be exposed in the bottom of it, where it may be found more or less connected with the thyroid gland; the intimacy of this union depends on the part where the tube is exposed; if in the vicinity of the cricoid cartilage and commencement of the trachea, these relations are found more close than elsewhere; after being separated from each other, the fingers are to be passed along the œsophagus, to discover if any arteries run on it, which may be thus avoided; the tube is then to be opened, and the substance extracted, either with the fingers, or the polypus forceps. After the wound has been dressed, the patient ought to observe the most absolute quietude, and not interfere with the union of the parts, so necessary for his well-being, by putting them into action.

The organs, the lesion of which is to be dreaded, during the performance of this operation, are, the carotid artery, the internal jugular vein, the thyroid arteries, and the section of the recurrent of the eighth pair of nerves, a wound of which will cause either a total loss of voice, or weaken it considerably. To avoid such important parts, the left side of the neck is to be preferred for the following anatomical reasons: the œsophagus, as it descends along the cervical ver-

tebræ, inclines slightly towards the mesial line of the neck, escaping a little from under the trachea; the carotid of this side, also runs at a greater distance from the same line, than what the right does, consequently will be less exposed to danger. As soon as the trachea is denuded, it ought to be disturbed as little as possible, for if the foreign body does not indicate itself, the air tube will be a certain means to find the œsophagus, which always lies under it.

Laryngotomy and Tracheotomy. The operation for penetrating into the tube which conveys the air into the lungs, considered by many so formidable an undertaking, is now rapidly yielding to the information derived from better directed views of the animal economy, and from a more intimate acquaintance with anatomy. Foreign bodies lodged in the trachea, also when situated in the pharynx, where, by their size they cause considerable difficulty of respiration, by the pressure which they exert on the trachea, demand this operation;—some rare cases of enlargement of the tongue, or amygdalæ, will justify the surgeon to undertake it;—also, for the purpose of inflating the lungs, in cases of suspended animation;—when boiling water has been swallowed, which causes such inflammation of the mucous membrane about the rima glottidis, and effusion into the lax submucous cellular tissue, situated in this place, as will prevent any air being admitted into the lungs; by the operation, the free ingress and egress of the air is preserved, and suf-

focation prevented, until all the inflammatory symptoms have subsided, when it will then resume its natural course.* When the operation is to be performed in croup cases, it is doubtful if it ought ever be done in the latter stages. For some very practical remarks on this operation in laryngeal diseases, the reader is referred to Mr. Porter's work on the Larynx.† Tracheotomy has been found of considerable utility when syphilis has attacked the larynx, which has hitherto baffled the attempts of surgeons to relieve, until the propriety of this measure was first advocated by Mr. Carmichael, of the Richmond Hospital, and first carried into execution by him, with the best results. Also in cases of polypi,‡ when they pass into the pharynx, and block up the rima glottidis: finally, in œdema of the larynx.

It is not my intention to enumerate the symptoms attending the cases demanding this operation, still it may be allowed, to allude to

* Dr. Burgess's Cases, Dublin Hospital Reports, vol. iii. p. 379. Some time since I assisted Mr. Palmer, of Mercer's Hospital, in a case of this kind, which he performed with his usual address; active inflammation followed, which was subdued by suitable remedies, and recovery of the little patient.

† In the fifth volume of the Dublin Hosp. Reports, which has appeared whilst this sheet is going through the press, the reader will find a successful and highly interesting case of this operation for chronic Cynanche Laryngea, by the same author.

‡ I assisted Mr. Gregory of the Coombe Hospital, not long since, in a case of tracheotomy, to relieve suffocation arising from this cause: I hope that these gentlemen will not neglect to give their cases to the Profession.

the remarkable remissions which occur in some of them; when a foreign body is lodged in the trachea, for example, the cough is only occasionally distressing, and is caused in consequence of the body being driven up against the larynx, which is so irritable, that the most harassing fit of coughing is excited till the foreign substance is either forced from the larynx, or recedes from it, when the fit ceases: In the same manner, the difficulty of breathing accompanying it, is also subject to remissions, sometimes absent, at others threatening instantaneous suffocation. In some cases related by Louis, emphysema occurred, owing to a rupture of some of the bronchial terminations. I have merely alluded to the remission of symptoms, that the young practitioner should not be lulled into any false security when he observes, that violent symptoms do not uninterruptedly accompany the presence of such substances; on which occasion he will derive considerable assistance, amounting to a certainty, from the use of the stethoscope, and obtain a clear diagnosis, as to the absence or presence of the foreign body in the air tubes.*

* A very interesting case occurred some months back, at the Meath Hospital, in which I was informed considerable doubts existed as to the propriety of the operation; these were removed, by having recourse to the stethoscope, which indicated in the most evident manner to Mr. M'Namara, (whose case it was,) that a foreign body was in the tube: he informed me that he could distinctly hear the passage of the body as it ascended the trachea and strike against

Laryngotomy. The patient being seated in a chair, and the head thrown back, or lying on a table with the shoulders supported by pillows, which allows the head to recede, that the throat may be rendered prominent; the space between the cricoid and thyroid cartilages, should be well observed, when an incision is to be made parallel to the median line of the neck from a little above the thyroid to a little distance below the cricoid cartilage; the lips of the wound are then to be separated, and the dissection cautiously continued between the sterno-hyoid, thyroid, and crico-thyroid muscles, until the crico-thyroid membrane is exposed. After this step, a careful examination of this space with the finger, is necessary, to ascertain if any vessel crosses it, if not the membrane may be divided from below upwards; but if a small artery runs on it, as is sometimes seen, it is to be protected from the knife before the membrane is perforated. In this operation, the skin, cervical fascia, and crico-thyroid membrane, are the only parts necessary to be wounded, while the line of incision passes

the larynx; he also stated, that the respiratory murmur was audible in both sides of the chest; but on one occasion, the right lung gave no respiratory indication, when suddenly something shot away, and the lung was instantly filled; this symptom, arising evidently from the momentary but complete blocking up of the entrance to the right bronchus. The evidences gained from the stethoscope were of the most satisfactory character, and confirmed in his mind the necessity of the operation, which was attended with the happiest consequences.

between the crico-thyroid and sterno-thyroid muscles.

Tracheotomy. The patient being similarly situated as in the last operation, and the position of the cricoid cartilage defined; from its inferior edge the incision should extend downwards, directly in the mesial line of the neck for an inch and a half, or two inches; it is better to prolong it to the first bone of the sternum, dividing the skin and superficial cervical fascia ; the operation is then proceeded in by cautiously penetrating between the sterno-hyoid and thyroid muscles till *the deepest layer* of the cervical fascia is seen, which is to be freely slit open, when the trachea is exposed: on being brought into view, it is to be fixed by pressing upon it with the left index finger, when the operator can enter the tube, by cutting from *below upwards*, with a sharp-pointed bistoury or scalpel, guided by the nail of the finger. This step is rendered often difficult, not alone by the rapid motion of the trachea, but also in consequence of the cartilages being ossified. The operator next insinuates a fine but strong hook into the trachea, transfixes it, then draws it from the wound to remove a portion of it with the knife or scissors, so as to make a free opening into that tube; when a canula is to be passed into it.*

* In the text it is advised to open the trachea, with a sharp-pointed scalpel; in some cases the urgency may be so great to an-

During the after treatment, he must be attentive that no air passes into the neighbouring cellular membrane for the first twenty-four hours after the operation, which will be productive of emphysema, and partially close the tracheal orifice.

For the necessity of tracheotomy "*en deux temps,*" see the observations.

Observations. In the text it is mentioned, that the incision should be about two inches in extent; this direction is in accordance with the generally received ideas of the operation; however, if the operator consults his patient's welfare, and his own convenience, I have no hesitation in pressing on his mind, the necessity of making it from the inferior edge of the thyroid cartilage to the top of the sternum; my reason for so doing is, that an incision of such a length, will alone permit the surgeon to expose the deeper-seated parts to his satisfaction, particularly in the necks of young children, which are always surcharged with adeps; and in full, muscular subjects; whatever haemorrhage may occur during the operation will be more under his control, the depth of the trachea will be more easily overcome, and the windpipe found,*

ticipate actual suffocation, that the trochar may be required to effect this purpose, as the necessary delay attendant on the dissection cannot be complied with. After the cutaneous incisions have been completed; by the trochar the respiratory tube is to be perforated: this proceeding requires some address, and might be followed by some unpleasant symptoms.

* I have known an instance in which a surgeon attempted to perform the operation on a child, and was obliged to give it up, as

while the aperture in it will never be covered by any alteration in its relations to the superincumbent parts : on the contrary, if the incisions are of the length usually recommended, whether the trachea is opened at the superior, or inferior angle, or in the part corresponding to the centre of the wound, the orifice in it will be covered by the superficial structures, as the tube is drawn upwards and downwards in each laboured respiration, which act as a valve occluding the aperture, to the great annoyance of the surgeon and distress of the patient. Should any cavil at the length of the incision here advised, as regards the deeper-seated parts, I feel satisfied that it is imperative, as far as the integuments are concerned. A most embarrassing circumstance attending this operation is the number of veins that often run on the anterior part of the neck ; if divided, they fill the wound with blood, which conceals the deeper seated parts, and when the trachea is being opened, the blood will necessarily flow into it, and cause great irritation. This inconvenience is to be obviated by a slow and careful division of the different tissues, and by keeping the wound well sponged, if possible to dryness. The presence of emphysema will add to the difficulties the operator has to encounter.

Occasionally, an artery as large as a crow-quill passes up the anterior part of the neck, derived from the arteria innominata, or the arch of the aorta, to supply a portion of the thyroid gland ; it has been named by some, the fifth or middle thyroid artery ;* if divided, it must be immediately secured. When the air tube is exposed it is often a very difficult matter to penetrate it in conse-

he absolutely could not find the trachea ! Porter's Surg. Observ. on the Larynx, p. 260.

* Scarpa.

quence of its rapid ascent and descent along the neck, caused by the dyspnœa that prevails ; it is recommended to open it from *below upwards*, as this proceeding completely protects the vena and arteria innominata, which are sometimes observed to lie above the first bone of the sternum, consequently are not defended by it ; this variety in the course of these two vessels particularly occurs in young children, before the thorax is fully developed. To the impediments already mentioned, other irregularities of vessels can be added ; as when both carotids arise from the arteria innominata, the left crosses the trachea pretty high in the neck. Scarpa met with one instance of this kind, and Burns with five.* To avail myself of the words of Mr. Burns :—“ These varieties in the course of the arteries, are worthy of being known and remembered ; they will teach the operator to be on his guard, since he can never, *a priori*, ascertain the arrangement of the vessels with any degree of certainty. It will impress on his mind, the impropriety of using the knife further than merely to divide the integuments and fascia. If he then clears the trachea with the finger, he will never injure any of the large arteries.” If either this operation, or laryngotomy, is performed in consequence of a foreign body in the trachea, it almost invariably happens that it is projected with considerable violence from the mouth, or through the wound, as soon as the air tube is opened ; if not, as immediate relief is procured, it is usual not to search for it, as it will be found in the lips of the wound in the course of twenty-four or thirty-eight hours. Numerous cases

* Burns' Anat. of Head and Neck, p. 394.

corroborative of this statement are on record;* † still the surgeon should make some examination of the trachea, with a gum elastic catheter or probe, to satisfy himself what has become of the body, before the patient is removed from the table.

If the foreign body cannot be found, or is not expelled, after this lapse of time, the propriety of the operation being again performed is to be considered, if no doubt exists of its presence in the air tubes ; this is what may be termed the operation "*en deux temps*," and is effected simply by enlarging the original wound ; if the foreign body is not then ejected, a long snipe bill forceps is to be introduced and passed along the trachea in search of it ; this examination is productive of considerable irritation (but it is imperative) ; if the body is not met with in the trachea, the operator must try the bifurcation of it, particularly the right bronchus, which runs a more ho-

* In the Journal Hebdomadaire, Saturday, Oct. 4th, 1828, an interesting case is given of a young man, who inadvertently swallowed a needle ; many ineffectual trials were made to remove it from the trachea, when the operation of laryngotomy was resorted to ; the tube being opened between the thyroid and cricoid cartilages, it was found impossible even then to extract the needle, when M. Blandin passed a director into the wound, and divided the former of these cartilages through the mesial line, for the whole of its extent ; it was even then impossible to extract it, for such violent fits of coughing attended the introduction of a forceps, as to compel the operator to desist. The wound was simply dressed ; the next morning the needle, one inch and a half long, was found lying in the wound, and easily extracted, the patient ultimately did well.

† Medical Gazette, vol. iii. p. 747. Case by M. Boyer ; the foreign body was not ejected till after the child was placed in bed.

horizontal course ; it is also larger than the left,* consequently more favourable for the entrance and lodgment of foreign substances.

Mr. Key,† in his very rare and highly interesting case of this operation, “*en deux temps*,” for the extraction of a sixpence, ascertained that a piece of money of that size could merely enter the left bronchus, while it passed a full inch into the right. Though his operation was unsuccessful (the patient dying during the performance of it, without any assignable cause either then or derived from the autopsy ; quere, as a vein had been wounded during the operation, could the entrance of air into it, be the cause of the symptoms described, and of the sudden-death ?) his surmise was correct, as to the situation of the sixpence.

In the autumn of last year, (1829,) Mr. M'Namara performed this operation,‡ “*en deux temps*,” the neces-

* Meckel, Anat. vol. iii. Cloquet, Anat. Des. vol. ii. The author's examination.

† Lancet, vol. ii. p. 661, 1828-9.

‡ A boy accidentally swallowed a plum-stone, which passed into the trachea ; the operation was performed, though the stone was not shot either from the mouth or the wound, (which almost invariably occurs in these cases,) still from the great relief afforded to the respiration, it was conceived that the foreign body was dislodged from the air tube, was thrown into the pharynx, and thence passed into the stomach by deglutition. Smart bronchitis supervened after the operation. Some symptoms occurred after the lapse of nearly a week, which induced Mr. M'Namara to presume the stone was still in the trachea ; by the aid of the stethoscope the presence of the body in it was detected ; a second operation was performed, which was very simple, when the stone was forced from the mouth, and the boy recovered. This case is alluded to in the Lancet of that period.

sity for which was indicated by the stethoscope. It has also been not long since executed by M. Graëffe.*

When tracheotomy is performed to relieve the effects of pressure upon the trachea, it will be necessary to introduce a tube into it, which is to be kept free of the mucus that is continually flowing into it.

Anatomical considerations of the neck, as serving to elucidate bronchotomy.—The following points in the anatomy of the larynx and trachea, as connected with the operations of bronchotomy, are worth attending to, viz. the situation of the os hyoides, its relation to the skin and thyroid cartilage, the position of the latter organ, and the manner of its attachment with the os hyoides and the cricoid cartilage; the manner in which the cricoid is united to the trachea, the course of this tube down the neck, and its anatomical bearing to the great blood vessels which run on each side, also the relations of the thyroid gland to the trachea. Finally, the alterations that the position of the head produces on the length and superficial situation of the larynx and the air tube of the lungs.—When the head is placed with the occipital condyles parallel to the horizon, six fingers' breadth will indicate the distance between the os hyoides and the top of the sternum in the adult, the three superior marking the space comprised from

Those valuable cases of Mr. M'Namara, are in the forthcoming volume of the Dublin Hospital Reports, vol. v.

The reader is referred to the Lancet for March, 13, 1830, for some interesting cases of this operation by M. Dupuytren.

* Medical Gazette, vol. i. p. 511; after the operation the bean could not be found; the next day the wound was enlarged, when the bean was extracted by means of a forceps.

the os hyoides to the isthmus of the thyroid gland, or the transverse slip which passes anterior to the trachea, one finger is equivalent to the perpendicular depth of the isthmus, and two can be placed between it and the top of the sternum. When the head is in this situation, by passing the finger down along the centre line of the throat, the os hyoides will be found about four fingers' breadth behind, and a quarter of an inch below the chin ; by continuing the examination, the thyro-hyoid membrane can be then perceived, and immediately below it the thyroid cartilage, which extends to some distance on each side of the neck from the mesial line ; inferior to this cartilage the cricoid is discovered, presenting a well defined point in the throat ; the space between it and the thyroid cartilage is filled up by the crico-thyroid ligament, on which runs a small artery, and is the situation for performing laryngotomy, properly so called : continuing the examination along the neck, the trachea is observed, descending on the median line, and apparently retiring from the surface, as it approaches the sternum ; by insinuating the fingers between the mastoid muscles, a little below the cricoid cartilage, a substance of a doughy consistence may be felt, whose limits cannot be well defined in the living subject ; it is caused by the thyroid gland ; when its connecting slip, which passes anterior to the trachea is well marked, its situation can be, with some care, ascertained : between this point and the top of the sternum is the place for performing tracheotomy. Such is the position of the anterior part of the throat, when undisturbed by any strained attitude ; however some alterations are produced in the various organs situated here, when the head is thrown back ; for instance, the os hyoides, thyroid and cricoid cartilages are brought forward, and become more superficial ; the

length from the chin to the first bone of the sternum is considerably increased, being capable of admitting twelve fingers between these two points, and an oblique line is observed, extending from one to the other, which will scarcely admit insinuating the thumb between the throat and it. The only part where room is gained for the purpose of operating in this forced position, is between the isthmus of the thyroid gland and top of the sternum, which is increased in length by the breadth of one finger. The following extract indicates how this is obtained : " When the head is in this position rather more than four and less than five fingers, can be placed between the chin and the upper margin of the thyroid cartilage, somewhat more than three fingers can be laid between the top of the thyroid cartilage and the superior border of the thyroid gland—then after deducting a single breadth of the finger for the gland, three fingers' breadth remain between the lower edge of the gland and the highest point of the sternum.*

CHAPTER IX.

LITHOTOMY IN THE MALE AND FEMALE.

THE urinary bladder, in the male subject, has been entered by lithotomists through the peri-

* Burns' Anat. Head and Neck, p. 68.

næum, and above the pubes, for the purpose of extracting calculi from it; no less than five methods have been devised for the purpose of penetrating into it through the perinæal region, which may be divided into the simple and the compound: by the simple plans, the urethra and bladder are alone interested in one situation; by the compound methods, organs not forming a part of the urinary apparatus are wounded, or the urinary bladder is opened in two different regions. They can be classed in the following order:—*1st*, the *operatio minor*, or *Celsiana*, which is performed at the posterior part of the perinæum; *2nd*, the *operatio major* or *Mariana*, which is performed in the mesial line of the same region; *3rd*, the lateral operation, first executed by Frère Jacques, and is performed either on the right or left side of the raphè; these constitute the simple sections: *4th*, the recto-vesical operation of Vacca and Sanson; *5th*, and the bilateral, include the two compound methods through the perinæum.

The operation above the pubes, also named the high operation, hypogastric, and supra-pubic, is either simple, when the superior fundus of the bladder is alone divided; or a compound operation, when the urethra is opened in perinæo, and the bladder in the superior fundus; as first introduced by Frère Côme, and still practised by Dr. Souberbielle of Paris.

The two first operations, those of Celsus and

Marianus,* are no longer performed; though consigned to the history of the successive improvements in lithotomy, still we must not forget the important axiom laid down in the description of the operatio minor by the Roman writer, who says, when speaking of the incisions, that they should be made "*donec urinæ iter patet sic ut plaga paulo major quam calculus sit,*" and expressly mentions some of the dangers that result from the incisions being too small. The Marian plan, though justly condemned for the laceration and contusion attendant upon its execution, still to it are surgeons indebted for being taught the use and value of the staff, as in the Marian method; this instrument was first employed, and subsequently adopted and improved by lithotomists, to guide their knives into the bladder. For a detailed account of the different steps of these two operations, the reader is advised to consult any of the medical dictionaries, or Sprengel's *Histoire de la Médecine*.

The next operation for the relief of urinary calculus, in an historical point of view, is that above the pubes or the supra-pubic section; as its introduction in this place would break in upon the detail of the simple operations in the perinæum, I prefer to postpone the account of it, till they are disposed of.

* This operation was first performed by Johannes de Romanis, but made public by his pupil Marianus Sanctus.

Lateral Operation. The essential characteristic of this method is to make an incision into the perinæum, extending from the raphè towards the tuber ischii, then to divide the subjacent parts in a similar manner, and to cut through the prostate gland and neck of the bladder, when the calculus may be extracted.

This very great improvement in lithotomy was first made public by an itinerant lithotomist of France, Frère Jacques, whose manner of operating can be recited in a few words:—having secured his patient, he introduced a full-sized staff without a groove into the bladder; he then plunged into that viscus a double-edged knife through the perinæum, between the staff, anus, and ischium; he next examined the wound with his finger, and if necessary dilated it, when a conductor was passed into the bladder, on it the forceps, and the stone extracted.* However imperfect, even dangerous, this plan was, as executed by Frère Jacques, it established a new route for the skill of the lithotomist, who sedulously examined it, both as connected with its anatomical and practical difficulties and advantages; from it M. Cheselden derived his information,

* For a full description of the operation, as performed by Frère Jacques, the reader is referred to *Observations sur la Manière de tailler dans les deux Sexes, pour l'Extraction de la Pierre, pratiquée F. Jacques, par J. Mery*; also to *Traité des Malad. Chirurg.* par Boyer, tom. ix. p. 340.

who brought the lateral operation to such perfection, as scarcely to leave any thing to desire.

For all practical purposes the lateral section of the bladder can be arranged under the following heads, in respect of the instruments required in it.

1st. A full-sized, and deep-grooved staff, a knife, a director or blunt gorget, forceps of various sizes, bandages to confine the patient, a syringe to inject warm water into the bladder, and a scoop to bring away calcareous fragments, and sabulous matter; in addition to these, ligatures to secure the bleeding vessels may be necessary.

2nd. The same instruments, to which have been added, the lithotome caché of Frère Côme.

3rd. The operation in which the instruments of number one are used, with the cutting gorget as invented by Sir C. Hawkins.

4th. The method as performed by the use of lithotomes differing in form from Frère Côme's, as those of Daunt, Peile, &c. &c., the beaked knife.

5th. The plan as performed in the Meath Hospital.

6th. The operation on the nearly straight staff, lately insisted on by Mr. Key.*

7th. The modifications of Frère Côme's lithotome, to meet the peculiarities of the bi-lateral operation.

† Section of the Prostate. London, 1824.

The Lateral Operation as performed at the present time with the simple knife. The surgeon should never neglect the salutary practice of preparing his patient for this operation, by gentle laxatives; if plethoric, one or two full venesectio-
n will be necessary, and if much vesical irritability exists, it must be allayed by suitable remedies. That excellent lithotomist, the late Professor Dease, who in eighty or ninety operations, scarcely lost a patient, attributed much of his success to a rigid preparatory treatment prior to the operation. Celsus was well aware of the good resulting from such care, as he enjoins that the patient should be brought into a fit state for the operation, by diet and abstinence;* it is also necessary that he should be placed on the table in as quiescent a state as possible, and a very short time before the operation an enema, containing a full dose of opium, ought to be administered to him; the surgeon will also find it of utility to induce the patient to retain his urine for some time before the operation, that the bladder may be fully distended.

Operation. The patient is secured in the following manner:—the legs are flexed on the thighs, and these on the pelvis, so that the heels may be close to the nates, and are then lodged in the palms of the hands, in which position

* Read M. Martineau's Paper, in the Med. Chirurg. Trans. vol. xi. p. 405, *et seq.*; on this point.

they are bound to each other, by soft but strong bandages ; that are applied thus, when doubled, a loop is formed in the centre of each, through which the wrists are passed and tied ; the tails of the bandages are then wound round the feet and hands, in the form of the figure of 8, till they are entirely expended.

The height of the table on which the patient is to be placed, will depend upon the surgeon, whether he operates in the sitting, kneeling, or standing position.

The patient is to be brought to the edge of the table, that the tuberosities of the ischia may project a little beyond it, the anterior sup. spin. processes of the ilia are to be as nearly horizontal as possible, and maintained in that position till the operation is completed ; while the back, shoulders, and head, are to be slightly raised, and supported by firm cushions or pillows ; the thighs are then abducted by two assistants, one on each side, who grasps the knees and feet to prevent the patient approximating them to each other, or to raise his pelvis from the table to the great annoyance of the operator. The staff having been introduced, and the presence of the calculus established, the operation is to be proceeded in ; if not, all surgeons unanimously agree that the operation should not be performed, but postponed to a more favourable opportunity. I have heard of a case in which one of the first surgeons in Paris, disregarding this injunction, ope-

rated and found no stone ; and another has come to my knowledge in which the surgeon was anxious for operating in nearly a similar manner ; fortunately for him the operation was delayed, and his character preserved ; the patient died some time after the intended operation, and not a vestige of a calculus could be detected in any portion of the urinary system.

First period. The presence of the calculus being indicated by the staff, the operation is to proceeded with ; the surgeon places himself before the perinæum (if the patient is laid upon a table of ordinary height) and kneels upon his left knee ; if he desires to render the right hand more steady, he rests the right elbow upon the corresponding knee ; he then takes charge of the handle of the staff, and holds it firmly with the thumb, index, and middle fingers of the left hand, while the ring and little fingers are extended along the staff portion to render it more secure, and maintains it perpendicular to the horizon, at the same time that he makes it to project into the perinæum, so as to mark the outline of the urethra. Some surgeons intrust the handle of the staff to an assistant ; this practice ought, if possible, to be discontinued, since the operator, if possessed of but moderate dexterity, can always hold it himself, which procures for him a sympathetic consensus between both hands, that can never exist when the staff is held by a second person ; another disadvantage is, if the as-

sistant is too intent on the various steps of the operation, he may neglect his duty, and allow the point of the instrument to slip from the bladder. However, it is usual with some surgeons to confide it to an assistant, who holds it in the manner just described: in the adult, an assistant is sometimes required to support the scrotum.

The surgeon, previous to making his incisions, should examine if the different lamina, that constitute the soft structures of the perinæum, form a thick or thin stratum; also if the perinæum is narrow or wide; an acquaintance with the first will point out the degree of force that he is to employ in penetrating them to gain the bladder; while the second will cause him to proportion the obliquity of his incisions to meet the varieties in the breadth of the inferior outlet of the pelvis. *Second period.* His great object is now to commence the incision, at such a point in the perinæum, and give it such a degree of obliquity as that no danger can be incurred of wounding the pudic artery, the rectum, or the bulb of the urethra; to protect the last-mentioned organ, some begin the incision a few lines from the anus, in which case, though they may not wound the bulb, still, if the usual direction be given to the incision, the rectum will be laid open: to shun this danger, but commencing at the point already mentioned from the anus, if a greater obliquity than usual be given to the incision, in order to protect the rectum, the pudic artery will

run considerable risk. Both these dangers may be avoided by commencing the incision at the raphè, one inch and a quarter, or eighteen lines anterior to the anus, and extending it obliquely downwards and outwards, for three inches midway between the anus and tuber ischii, boldly and freely dividing by the first incision, the skin and superficial fascia. *Third period.* The second incision he begins a little posterior to the anterior angle of the first, a few lines, or quarter of an inch, and divides a quantity of fat, the transversus perinæi artery, and muscle, with a few of the anterior middle fibres of the levator ani m.; if much adipose substance is present, it will be necessary to repeat this incision, for the better exposing the line of cellular membrane between the accelerator urinæ and the erector penis muscles, through which the knife penetrates to open the membranous portion of the urethra, immediately behind the bulb. *Fourth period.* These parts being divided, the point of the knife is then to be entered through the membranous part of the urethra into the groove of the staff, and posterior to the bulb; to effect this purpose some surgeons resign the staff to an assistant, and with the left index finger in the wound, search for the groove, at the same time pushing the bulb and rectum to the opposite side; having fixed the nail on the urethra, they conduct the point of the knife along it into the membranous portion; on the contrary, other ope-

rators more dexterous, never part the staff, after the preliminary incisions have been made, but pass the index finger of the right hand into the wound, and mark with it the point of the urethra, which it is necessary to pierce posterior to the bulb, in order to gain the groove, which is then accomplished by passing the knife into the centre of the wound and elevating the point of it, at the same time throwing the hand a little backward; (it is incumbent to observe in this place that the attempt to penetrate the urethra at the anterior angle of the incision should never be made, for to a certainty the bulb and its artery will be injured, giving rise to a very copious and distressing haemorrhage;) when the knife is in the groove, the operator convinces himself of it, by rubbing the point from side to side; he then lateralises the knife, and opens freely the membranous portion of the urethra.* *Fifth period.* The operator now depresses the handle of the staff between the legs of the patient, by which

* It is a matter of the greatest importance to the successful, and indeed to the safe performance of this operation, that a considerable portion of the membranous part of the urethra should be divided before the staff is depressed, or that incision commenced, by which the prostate and neck of the bladder is divided: for if you have entered the knife high up in the perineum, and while the point of the knife is lodged there, should depress the staff, and attempt the division of the prostate, you will have to make it describe a portion of a circle, at the time that it is dividing very resisting parts.—Colles's Surg. Anat. p. 211.

manceuvre the point or beak is raised from the rectum, ascends behind the pubes, and removes the remainder of the membranous and prostatic portions of the urethra from the intestine; also, this altered position in the staff presents the straight part of it for the knife to pass on; again, attending to the lateralization of the knife, the surgeon propels it steadily and slowly along the groove into the bladder, dividing what remains of the membranous part of the urethra, also the triangular ligament of the urethra, Wilson's muscle, together with the prostate gland and the neck of the bladder, which is announced by a gush of urine, and by the absence of resistance.

Sixth period. The scalpel is then withdrawn, in the direction of the first incisions, the operator still most attentive to its lateralization, dividing, if necessary, an additional part of the prostate near its base, and any septa that may be in the wound, consisting of portions of the triangular ligament, of the urethra, some of the fibres of the transversus perinæi m., with a few of the anterior fibres of the levator ani muscle.

It will be perceived that depressing the handle of the staff as preparatory to dividing the neck of the bladder and prostate, has been described as a distinct step in the operation; some, however, have so much address that by a double movement, they depress the handle of this instrument, at the same time that they pass the knife into the bladder; this manœuvre carries

with it an air of great dexterity, but is by no means necessary to the success of the operation.

This very important step of the division of the neck of the bladder and prostate, requires a full and perfect acquaintance with the anatomy of the parts, and their peculiar relations, also of the depth or thickness of the perinæum; if the plunge is too strong, in all probability the bladder may be transfixed, and the cavity of the peritoneum laid open; if not passed sufficiently deep, the bladder will not be reached, and a fresh trial will be necessary for that purpose: should the knife slip from the groove, it may pass posterior to the prostate and wound the rectum, or go between it and the bladder; if not sufficiently lateralized, as it is cutting the membranous part of the urethra, the rectum will be laid open at its anterior aspect; whilst on the contrary, if it be too much lateralized when the knife is being withdrawn, and the section of the prostate being completed, the pudic artery will be considerably endangered.

Seventh period. Extraction of the Calculus. When the bladder is opened, which is generally indicated by a smart gush of urine through the wound, the next proceeding is to introduce the index finger of the right hand along the staff, which is then to be withdrawn, to ascertain the situation of the calculus in the bladder; upon the finger so situated a blunt gorget is to be passed into this viscus, on which the forceps with

the blades closed is to be conducted;* many avail themselves of this instrument as a kind of sound to discover where the stone lies; should it not be found readily, the point of the forceps must then be carried behind the pubes, towards the superior fundus, where it may be confined by what is termed the hour-glass contracted bladder; sometimes it will be found in the inferior fundus, lying completely beneath the wound in the bladder: if any delay arises in detecting the calculus, the operator should immediately introduce his finger, well oiled, into the rectum, which enables him to raise the calculus from the inferior fundus; if it is placed in that region, it will also allow him to accomplish another not unimportant object, namely, to seize it in the forceps, as the finger prevents the stone receding from whatever attempts are made to grasp it with that instrument. The calculus being found, it is then to be extracted, which is by no means a trifling part of the operation; to accomplish it in the most perfect way, the forceps ought to be drawn

* If the forceps is introduced into the bladder without the guidance of the blunt gorget, much greater care must be paid to this step—for if it is entered horizontally, great risk is incurred of passing the instrument into the cellular membrane between the bladder and rectum, however complete the division of the bladder may have been. For the edges of the wounded levator ani contracting expose this interspace, which now feels as a cavity in consequence of the retraction of all that cellular membrane which lies between these parts.—Colles's Surg. Anat. p. 213.

in the axis of the pelvis, or what is better, in the direction of a line that will pass from the umbilicus to the tuber ischii of the side, at which the perinaeum is opened. Surgeons, even those possessing considerable dexterity, often perform this step in a very bungling manner, owing, I apprehend, to forgetfulness, from the following circumstance:—when introducing the forceps, they remain on the knee till the calculus is grasped, they then rise and endeavour to extract it; how do they manage this? by drawing out the forceps in such a manner, that they press it against the arch of the pubes, in consequence of elevating the handle too much, as they forget their own altered position, from kneeling to that of standing, which they should bear in mind, and keep the hand depressed, being the most favourable position to extract the calculus, as the forceps will then be made to pass in the proper direction.

The force that is necessary to be exerted to bring away the stone, ought to be gradually and cautiously applied, as it will allow the parts to yield and accommodate themselves to it, whilst passing through them; if a contrary proceeding is adopted, violent laceration and contusion will be the result, and severe inflammatory symptoms supervene. In the various manipulations necessary to introduce the forceps, and to extract the stone, too much gentleness can scarcely be employed, so that as little laceration as possible should be caused.

Besides the embarrassments already mentioned, that attend the extraction of a calculus, others exist which it is incumbent to enumerate: 1st, the incisions may be too small, which will permit the soft parts to act in the manner of a stricture, and prevent the ready removal of the stone; too many surgeons, to overcome such an impediment, drag with all their might, which often undoubtedly succeeds, but at the expense of much suffering to the patient, and subsequent inflammation; in place of acting in this way, when they perceive the passage too narrow, they ought to hold the forceps in the left hand, and with the right conduct a scalpel into the wound along it, which they can enlarge without any danger to the patient, and bring away, the stone with the greatest ease: 2nd, if the calculus is taken hold of by the forceps in its longest diameter: 3rd, from the presence of many calculi, all of which are to be taken away, or the operation fails; the operator is aware that many are present from the smooth and polished appearance which they exhibit: 4th, in some cases the stone cannot be found, though it is really in the bladder; when such a sinister event occurs, after all justifiable search has been made for it, the patient ought to be placed in bed, when in all probability, after the lapse of some hours the stone will present in the wound, or the operation "*en deux temps*," will be necessary: 5th, a soft stone often causes considerable delay, owing

to its breaking, which necessitates the frequent introduction of the forceps ; to guard against this accident as much as possible, the surgeon ought not alone in this case, but always when extracting a calculus, place either two or more fingers of the disengaged hand, or some solid body, between the handles of the forceps, to prevent their complete closure ; which is the only means in his power to obviate such an occurrence : it is absolutely imperative, when a calculus breaks, not to rest satisfied with removing the fragments, but also to inject warm water into the bladder, and wash away any sabulous remains : 6th, the calculus may be too large to pass through any opening that can be made with safety to the patient in perinæo, by the lateral operation : if possible, this ought to be ascertained beforehand, and the expediency of operating either above the pubes taken into account, or by the recto-vesical, or bi-lateral method : 7th, where calculi have been encysted, in some few instances, they have been successfully removed by dividing the sacculus formed by the bladder which confined them : 8th, a stone may be pedunculated, and the stem impacted in the ureter ; this variety demands some attention when the surgeon is extracting it, not to break the peduncle or injure the ureter : 9th, when the bladder is small or contracted, on the stone, the peritoneum may be situated between the inferior fundus of the bladder and the rectum ; or by the violent action of the abdominal muscles

it may be forced outward into the wound, from whence it might occur that the serous membrane may be caught in the forceps and lacerated, or it may be wounded by the knife if the section be imprudently made.*

Advantages of the Knife. The hand of every surgeon is made and accustomed to the scalpel, it is more under his command in case any untoward circumstance should occur, than any other instrument, consequently it can be better applied to the exigencies that present themselves, and it is an instrument that can be obtained in any quarter of the globe, whilst the other instruments intended for this purpose can be had but in certain places. When properly handled, and the anatomy of the perinæum accurately known, the student, if he consults his own interest, will always select it as one of the best and safest means to open a passage into the bladder.

The following operations have been invented by surgeons to render the lateral operation more secure and better fitted for less skilful operators than the method just described; some of them are deserving of much attention.

Operation with the Lithotome, or Bistoire Caché. The staff being exposed in the membranous part of the urethra, as already described,

* Camper Demonstrationum Anatomico-Pathologicarum, tab. ii.
fig. 3rd, σφτ.

when operating with the knife, and the lithotome set, the point of it is introduced into the groove, and the handle of the staff depressed, whilst the instrument is passed along it into the bladder; the staff is then withdrawn, and the bistoire caché lateralized to the proper degree; the operator then seizes it about the centre, with the left hand, and elevates it against the symphysis pubis, and towards the right side; this manœuvre separates the membranous part of the urethra from the rectum, he then presses the lever attached to the blade, against the handle, which places it in a fit position for acting as a cutting instrument, and withdraws it, dividing the neck of the bladder and prostate to the requisite extent.

Advantages of the Lithotome Caché. When used by a person not very dexterous, there is less danger of committing mischief than when he operates with the knife; though with the former he may commit the same errors as are sometimes attendant on the latter: the blade of the lithotome has been known to break during the division of the parts. Still the risks are so much less probable with it, than with the knife, that an operator not possessed of the requisite confidence, ought to prefer it to the latter; the bistoire caché has deservedly obtained the praise bestowed on it.

Operation with the Gorget. We are indebted to Sir C. Hawkins for introducing this instru-

ment into practice to divide the neck of the bladder and the prostate gland; since its first introduction various improvements have been made in it, by different surgeons, as MM. Cline, Abernethy, Scarpa, Cooper, still leaving it a bad and a dangerous instrument.

After the staff is laid bare, in the membranous portion of the urethra, the beak of the gorget is passed into the groove of the staff, the handle being then depressed, and the gorget properly lateralized, it is forced through the parts intended into the bladder; this being effected, it may then be converted into a director for the forceps, and the stone extracted.

Disadvantages attending the use of the Gorget. It requires the application of considerable force to penetrate into the bladder, which is always an imperfection in the application of surgical instruments; it is very liable to slip from the groove of the staff, and pass between the bladder and the rectum, or between the first organ and the symphysis pubis; or it may run by the side of the bladder and pelvis; the force that has been exerted on some occasions has been sufficient to tear the prostate from the urethra: the section of this body, if not sufficiently large the first time it is made, cannot be increased by the same instrument at a second attempt. From personal observation I can say nothing of it, having but seldom seen it used, and never in this city. What does one of the most experienced and suc-

cessful lithotomists of the present day say of the gorget?—"In the first years of my practice I was not very successful; and often witnessing many untoward circumstances in myself and others, which appeared to arise from the cutting gorget, I determined to lay that instrument aside, and employ the knife only, and the *blunt* gorget as a conductor for the forceps."*

If the student is desirous to practise the use of this instrument, he ought always, after having penetrated the groove of the staff, carry the knife onwards, and make a slight incision or nick into the prostate; by doing so, when he comes to use the gorget, he will divide the remainder of the gland with greater facility than if this had not been tried; to be aware of the benefit derived from this proceeding, let him attempt the division of a prostate without this preliminary incision, and one in which it has been made, and I am confident he will immediately decide in favour of the latter method.†

Operation with the Lithotome, as used by DAUNT, PEILE, &c., also with the beaked Knife. The membranous portion of the urethra, and anterior part of the prostate being divided, and the handle of the staff depressed, the beak of the conductor is entered into the groove of the staff,

* Martineau's Med. Chirurg. Transact. vol. xi. p. 405.

† *Vide Key*, from page 12 to 22, for some able criticisms on the use of the gorget.—*Section of the Prostate*, London, 1824.

the right wrist is then lowered as the conductor is pushed along the staff till it is fairly introduced into the bladder. The urine now flows along the groove of the conductor, assuring the operator of the success of this step. The staff is now withdrawn, while the conductor is kept fixed in the bladder, which, the operator having risen from his knee, raises as high as possible into the pubic arch, and holds it steadily in this position, by which alone a wound of the rectum can be avoided. Then holding the lithotome between the thumb and two fingers of the right hand, the beak is laid upon the lower edge of the groove, and pushed on until its point has passed into the external incision, when it is to be given the necessary lateralization by turning the groove of the conductor more or less towards the arch of the pubis. The proper degree of lateralization being given to the lithotome, the operator pushes it on, running close and parallel to the conductor, until it is stopped at the point of the conductor. It is then to be withdrawn by bringing it back along the groove. By this means the prostate is divided with the slightest possible force, for the operator is scarcely sensible of any resistance, and judges that it has been divided not so much from his having overcome a certain degree of resistance, as by the knife having reached to the end of the groove. The lithotome having been withdrawn, the wound and section of the prostate are to be examined, and if sufficiently large,

the forceps is then to be used; but if it is considered to be too small, the lithotome is to be again introduced along the conductor, the handle being separated from it, by which the division of the prostate will be in proportion to the degree of separation between the handle of the lithotome and staff of the conductor.

The great advantages of this mode of operating are, that any man who can lay open the groove of the staff in the urethra, and has dexterity enough to introduce along it the straight conductor into the bladder, will certainly guard against dividing the rectum, will be enabled to give the required lateralization, which is secured without any further dexterity in making the incision, and therefore he will be able to avoid, in every instance, the division of the internal pudic artery.—*Colles*, p. 218.

The beaked knife is applied for the same purposes as these different lithotomes, and used on the same principle, after the lateral incisions have been made, and the groove of the staff laid open in the membranous part of the urethra.

Operation as performed in the Meath Hospital. It remains for me, before concluding the lateral section of the bladder, to introduce to the student Mr. Crampton's modification of this operation, which is remarkable for its very great safety, also being fitted for the adoption of the most inexperienced. It consists in the use of a particular kind of lithotome or knife, that is nar-

row, straight, and probe-pointed ; the edge occupies about two inches in length, or not so much, and commences about a quarter of an inch from the point, and the blade is not more than one quarter of an inch wide.

The lateral incisions are made in the usual manner; the membranous part of the urethra, and the apex of the prostate being cut into, the lithotome is passed by the groove of the staff into the bladder; no force is necessary for this purpose, the blade being so narrow as to occupy but very little space ; the staff is then withdrawn, when the proper lateralization is given to the lithotome ; the operator passes the left index finger along the back of it, forcing his way gradually into the bladder, by which means the division of the prostate is effected on the principle of the wedge by the lithotome, for the whole of its depth from apex to base, as the breadth of the finger and blade of the instrument, taken together, equal the space comprised between the apex and base of the gland. By this manœuvre it is impossible to divide any vessel, as the lithotome does not act on the ordinary principle of cutting instruments, namely, that of a saw, since no sawing motion whatever is communicated to it; nor do I think if such an irregularity should be encountered as that which unavoidably proved fatal in the hands of the late Mr. Shaw, would the vessel be opened, as it would either sink into the lax cellular membrane of this region, or turn from the knife, and so elude it.

I have witnessed the operation performed with this instrument, by M. M. Crampton, Hewson, and Porter, and feel pleasure in bearing testimony of the celerity and safety with which it was effected.

I have also had such an opportunity of appreciating the value and safety of the lateral section of the prostate and neck of the bladder, by this method, that in my mind it supersedes the use of the plans already detailed; and if lithotomy was to continue for any length of time as a part of Operative Surgery, I have no doubt but it would be very generally adopted.

Mr. Key, of Guy's Hospital, in his interesting work on the Section of the Prostate, advocates the advantage of cutting on a staff nearly straight, in place of the ordinary curved one; the staff he recommends is perfectly straight to within an inch of the point, where it is bent so as to form a very large obtuse angle; it is introduced into the bladder, and held in the usual position by an assistant, and the operation performed by means of a scalpel.

The great advantage gained by this instrument is from being straight, which answers all the purposes of a director, along which the knife runs when dividing the neck of the bladder and the prostate; it also admits of being lateralized to any extent, and by diminishing or increasing the angle between the staff and knife, the size of the opening through the prostate will be

known. The operation is nearly similar to the lateral one already described, except that Mr. Key advises making the section of the prostate as the knife enters the gland; if it is not sufficiently large to admit the calculus, it must be then enlarged.

I have occasionally exhibited this method of operating to my pupils, and satisfied them of the perfect security with which the knife passes along the groove of the staff, to make the requisite section of the soft parts: I have also convinced them of the facility, that a straight sound can be introduced through the male urethra into the bladder.

For further remarks upon this last point of practice the reader is referred to the Anatomy of the Perinæum, and to Catheterism, in the subsequent part of this work.

Accidents attending the Lateral Operation. The two principal ones immediately connected with it, are hæmorrhage and wounds of the rectum: the sources from whence the former may occur, are five-fold, some of which cannot be avoided; 1st, the transversalis perinæi artery must be cut across; seldom any alarming bleeding follows; if it does, the vessel can be readily secured in a ligature. I lately witnessed a case in which it was necessary to tie this vessel, the hæmorrhage was so smart: during a few seasons back, when demonstrating the perinæum, I observed this artery was of considerable size, even larger than that of the bulb; 2nd, the artery of the bulb is liable to be wounded, when the incision is

commenced too high; the flow of blood from this vessel will be considerable, and it will be a difficult matter to pass a ligature about it, being not alone situated in a deep and narrow wound, but it retracts under the protection of the triangular ligament of the urethra, and so eludes the attempts made to take it up; the bleeding from it in many cases can only be arrested either by the actual cautery, or by compression; 3rd, the external haemorrhoidal vessels will be endangered if the incisions are extended too far back, *i. e.* much beyond a line that passes from the tuber ischii to the anus: 4th, the internal pudic will be opened when the knife is too much lateralized, and carried too near the ramus of the pubes: 5th, in some, particularly old people, a considerable venous plexus surrounds the prostate, which must be opened, when that organ is being divided, and will afford some blood. When the internal pudic is wounded,* or if a general oozing of blood continues and cannot be arrested by cold effusion and such simple means, it will be necessary to plug the wound, which may be effected in the following manner: a full-sized catheter being passed through a large piece of sponge, enveloped in soft old linen, is then to be introduced into the bladder, which

* In some most rare instances, the pudic artery does not pass out of the great sciatic foramen, and enter by the lesser to arrive at its destination, but courses round the pelvis, makes its exit from that cavity, by the side of the prostate gland, under the pubic arch; if such a distribution occurs in a patient the subject for lithotomy, and that the lateral operation is performed, it will be almost impossible to avoid that vessel, as it actually runs in the very line of the incisions; what is equally unfortunate, nothing will inform us of this variety, but the appearance of the haemorrhage.

permits the urine to flow, while the sponge, absorbing the fluids as they issue from the wound, swells, and by compressing the vessels, arrests the hæmorrhage ; some prefer filling the wound with graduated compresses having previously passed the catheter. In cases of a general oozing of blood, the compression may be efficacious, but little is to be expected from it when the internal pudic artery is injured ; however, by compressing the vessel as it lay on the spine of the ischium, hæmorrhage from it was restrained ;* Dupuytren is an advocate for the actual cautery.†

Injury of the Rectum. This intestine may be wounded as the knife passes along the membranous part of the urethra into the bladder, or as it is being withdrawn from this organ, to cut its way outwards ; in the first instance, if the handle of the knife is too much elevated, and the blade propelled forward without being sufficiently lateralized, nothing can prevent it dividing the thin partition between the canal of the urethra and the rectum, and opening into the cavity of the latter ; the accident is immediately indicated to the operator by the escape of flatus and some feculent matter ; in the second case, when the cutting instrument is being withdrawn, particularly if it is the lithotome caché, should the patient struggle much, the viscera will be pressed into the pelvis, when the rectum may be driven forcibly under and before the prostate, which will expose it to considerable risk of being cut on its anterior surface ; this perforation is generally more dangerous than the preceding one, as it is

* Harrison's Anat. of the Arteries, vol. ii.

† Thèse de la Lithotomie, p. 26.

always deeper seated and more extended ; it is also more likely to be attended with recto-vesical fistula. It sometimes happens that the gut is unusually dilated, admitting the inferior fundus of the bladder, and prostate gland to be imbedded in it ; this dilatation is oftenest met with in old men, and is most probably due to a mechanical cause ; the fæces being allowed to collect in quantity in the rectum, will ultimately so enlarge it that a sacculus will be formed on each side of the bladder. As such deviations are to be suspected in those advanced in life, previous to operating, an examination of the rectum should be instituted, to ascertain if any unusual dilatation present ; when this is the case, we are recommended by some to make but a small incision into the neck of the bladder and prostate, then to enlarge it by dilatation, or if the calculus is full-sized, to employ the apparatus major,* or should it be very large, to resort to the apparatus altus. It appears very singular that this celebrated surgeon should recommend dilatation, and still more the revival of the operatio major ; when all the difficulties can be surmounted by adopting one of Cheselden's methods, namely, to resign the staff to an assistant, and pass the index finger of the left hand into the wound, and press the rectum to the right side, which will completely protect it from whatever cutting instrument divides the prostate and neck of the bladder.

In young children there is also much danger incurred of wounding the rectum, in consequence of the bladder being at that time of life on a higher plane than at any other period ; also in early life the prostate is very small,

* Dupuytren's Thèse, p. 28.

which admits of a closer connexion between the bladder and rectum. Finally, sometime after the operation, the rectum is liable to be opened by gangrene, when a large calculus has been extracted, as the parts through which it has passed may be so lacerated and contused, that nothing can prevent this from occurring; it generally supervenes from the eighth to the fifteenth day after the operation.

Suppurative inflammation of the reticular cellular membrane, surrounding the bladder, often succeeds to much laceration of these parts, caused either by the extraction of the stone, or by the force attendant on the use of the gorget.

The high Operation, or the supra-pubic Section of the Bladder. This method was introduced from necessity by Lanfranco; who failed to extract the calculus by the Marian operation, owing to its size, when he operated above the pubes with success.

Since his time, surgeons have been obliged occasionally to resort to this operation; for instance, when the calculus is so voluminous that it cannot be extracted by the lateral section;—when the prostate gland is enlarged and otherwise diseased;—or in cases of stricture in the urethra. The operation above the pubes is more feasible in the young subject than in the adult, as the bladder in the former ascends higher above the pubes than in the latter, by which the peritoneum is better protected, the arch of the pubes is also less deep in the young than the old,

which causes the bladder to be more superficial in the former than the latter.

Operation. . The pubes being shaved, the patient reclines upon a table of moderate height, his legs hanging over the edge, and the feet supported upon chairs and confined by assistants; the bladder being previously injected with tepid water to distend it, as recommended by many surgeons, or simply by the accumulation of urine. *First period.* The surgeon, placed between the legs of the patient, stretches the skin with the left hand, and makes an incision from three to four inches long, above the pubes, through the common integuments, parallel to the linea alba; it being exposed, the tendons of the external and internal oblique muscles, also of the transversalis abd. are to be divided to the same extent; the mesial edges of the pyramidales and recti m. are next seen, between which the surgeon penetrates in the most cautious manner, and comes down either upon a great quantity of cellular membrane, loaded with adeps, or containing but a small quantity of it. *Second period.* The surgeon then introduces his index finger into the wound, to examine for the bladder and its position; if it has risen above the pubes, or is on a level with it, he instantly recognises it, and desires his assistant to pass two of his fingers into the wound, to support the peritoneum, and prevent it being forced either below the pubes, or through the solution of continuity, during the subsequent steps

of the operation ; an accident likely to occur if the patient is very restless, and throws his abdominal muscles into violent action. *Third period.* The exact position of the bladder being ascertained by the surgeon, he penetrates it with a scalpel, downwards towards the pubes, and makes an opening of sufficient extent for the passage of the calculus : by entering the bladder in this manner, in place of the opposite, the peritoneum is better protected, as the edge of the knife is turned from it, and cuts in a contrary direction. *Fourth period.* On the vesical incision being perfected, some surgeons introduce the index finger into the bladder to prevent it receding from the wound ; this precaution is better provided for by means of a small hook passed into the bladder, which having transfixed it, retains it equally well with the finger, and occupies less space. The forceps is then passed into the bladder, and the calculus extracted in the axis of it : the introduction of this instrument should be always effected in the most careful manner, so as to disturb in the slightest degree possible, the connexions of the bladder with the surrounding parts, which to a certain extent guards against urinous infiltration, an occurrence always pregnant with mischief. It being ascertained that no calculi remain in the bladder, the wound is to be dressed and the patient placed in bed.

Objections to the supra-pubic Operation. It is a dangerous operation to perform on those who

are very fat; and in those in whom the bladder is not capable of much distention, it should at least be above the pubes; the peritoneum is very liable to be wounded—or to become inflamed after it; often urinous, purulent, and gangrenous effusions into the pelvic cellular membrane succeed to this operation, as the urine more readily escapes from the wound of the bladder into the surrounding parts, than through the integuments; for the bladder, by its contraction, sinks below the pubes, which alters the parallelism between the superficial incisions and the deep ones which interest the urinary reservoir. Of late years it has been attempted to obviate the escape of the urine into the surrounding cellular membrane, by passing a piece of tape, or some such conductor, into the bladder, and to allow the external end to hang over the pubes, which, by capillary attraction, conducts the urine outwards without permitting any portion of it to be effused.

COMPOUND OPERATIONS.

To prevent the accidents that occasionally occurred, in the hands of the most skilful and experienced surgeons, when performing either the sub-pubic or supra-pubic operations of lithotomy, those plans, which I denominate compound, have been invented; they have been often executed, but with no great success, and are now seldom or ever practised, and for very obvious reasons, as they render the simple operation, which is suffi-

ciently hazardous, doubly so, by causing either two openings to be made into the bladder, or implicating another viscus in the plan adopted; diminishing, in this way, in no trifling degree, the probable success of the operation.

First plan. This operation consists of a combination of the high operation, with the first steps of the lateral section, and is conceived by its inventor, Frère Côme, and advocates to remedy the ill effects that so often ensued to the supra-pubic operation. To execute it, the surgeon should be provided with a scalpel, a straight and curved staff, both grooved, a *sonde à fleche* or *dard*,* and two or three small hooks, besides the other instruments used in lithotomy. *First period.* The patient being secured as for the lateral operation, and the presence of the calculus proved, the curved staff being passed through the urethra into the bladder, is confided to an assistant, who inclines the handle to the right side, while the surgeon, having rendered the skin of the perinæum tense with the left hand, makes an incision to the left of the raphè, about one inch in extent, and proceeds to open the membranous portion of the urethra, as described in the lateral operation. *Second period.* The canal be-

* The *sonde à fleche* or *dard*, as used by Frère Côme, consists of a spear or dagger-shaped knife, inclosed within a sheath, both curved; on the concave side of the knife runs a groove, along which the bistoury that enlarges the bladder is conducted.

ing penetrated, the straight conductor is passed along the curved one into the bladder, and the latter then withdrawn; the operator next slides the "*sonde à fleche* or *dard*," on the conductor into the urinary reservoir, and withdraws the conductor, allowing the "*sonde à dard*" alone to remain in the bladder, which he gives in charge to an assistant. *Third period.* The high operation is then to be performed in all its details, till the bladder is fully exposed. *Fourth period.* When the operator resumes the "*sonde à dard*," having the left index finger on the bladder, he, with his right hand, pushes the *sonde* upwards behind the pubes, to the superior fundus of the bladder, so as to raise it above the line of the peritoneum, and by gently continuing the pressure on the *sonde*, this region of the bladder is carried outwards through the wound, and is instantly seized by the surgeon, who desires his assistant to force the stilette of the *dard* through this portion of the viscous, which he also lays hold of, and glides along the groove in its concave side, a probe pointed bistoury, cutting through the anterior wall of the bladder. *Fifth period.* The assistant then draws the *sonde à dard* within the sheath, and removes it from the bladder, immediately after he introduces his finger into this viscous through the wound above the pubes to prevent it subsiding below the bone. *Sixth period.* While the surgeon examines if the incision into the bladder is sufficiently large, if not, it is to be

extended, and the calculus extracted as already mentioned. *Seventh period.* A gum elastic catheter is then passed into the bladder by the perinæal opening, and a small slip of linen into it by the supra-pubic wound, by which any portion of urine that may be extravasated will filter and pass outwards.

This operation is equally applicable to the female, the *sonde à dard* being introduced by the urethra. Since Frère Côme's time, this method of operating has scarcely received any improvement: it is at the present period performed by, I believe, but one surgeon, M. Souberbielle of Paris, and with great success.—A few years since, 1820, Sir E. Home extracted calculi by a slight modification of this operation:—he made no perinæal incision, but introduced a catheter with a concealed stilette into the bladder: when the supra-pubic incisions were completed, he raised the superior fundus of the bladder above the pubes by means of the catheter, pierced it and enlarged the incisions with a probe-pointed bistoury.

The advocates of this compound operation, attach no danger to the incision in the perinæum; it cannot be denied that it is adding to the number of incisions, which do not improve any operation; but they maintain that the following advantages accrue from it:—a free exit is formed for the discharge of the urine, which prevents any urinous infiltration behind the pubes, that

so frequently succeeds to the simple high operation ; in fact, say they, it combines all the advantages of the hypogastric operation, without any of its dangers. Will the contents of the bladder be discharged in this desirable and uninterrupted manner ? M. Dupuytren states, that whatever precaution is observed to preserve the catheter free, it will fail, and the urine, after the adhesive inflammation has taken place, will pass out by the supra-pubic wound.* According to the same authority, it is by no means an easy matter to pass the *sonde à dard* between the stone, if it is large, and the bladder, to make it appear above the pubes ; which is rendered more difficult if the bladder is at all contracted upon it.

Second plan. *The recto-vesical Operation.* The instruments necessary for it are a grooved staff, a narrow-bladed scalpel, a forceps, and a probe-pointed bistoury. The patient being placed and secured in the position for the lateral operation, the staff is introduced into the bladder, and held perpendicular to the symphysis pubis, with the groove corresponding to the raphè ; the surgeon standing in front of the perinæum,

* En effet quelques précautions qu'on prenne, les urines coulent difficilement et en petite quantité par la canule placée au perinée, et l'adhérence qui s'établit entre les parois de la vessie et celles de l'abdomen, fait bientôt, de la plaie supérieure, le centre des contractions de la vessie, le point où les urines se portent et celui par lequel elles s'évacuent.—Dupuytren's Thèse, p. 44.

having the left index finger well oiled, with the scalpel laid flat upon it, the edge and back regarding the tuber ischii of each side, who is also careful to press the edge of the knife against the pulp of the finger, so as to be completely imbedded in it, which protects the rectum from any wound, when the knife and finger are being passed through the anus into that intestine. *First period.* The left index finger thus armed, is introduced into the rectum, the dorsal surface of it being turned towards the sacrum, and the palmar to the symphysis pubis, till it has passed an inch, or an inch and a quarter into the intestine; the finger is then pressed backwards to allow a change in the position of the scalpel, which is effected by the right hand that holds it, which turns the back towards the palmar surface or pulp of the finger, and the edge towards the raphè or symphysis pubis; the sides of the knife are consequently changed from the position they were in prior to its being conveyed into the rectum, and look towards each ischium, in place of being anterior and posterior. The finger of the left hand that supports the scalpel is to be carried forward against the anterior part of the rectum, at the same time that the right hand withdraws the scalpel, which divides the anterior parietes of the rectum, the cellular membrane lying between it and the urethra, together with the external sphincter ani m., beyond which the incision ought not to extend farther than six

or eight lines into the perinæum. *Second period.* The operator next introduces the left forefinger into the wound, to search for the groove in the staff; when found, he places the nail in it, and conducts by it the scalpel with his right hand, the back being to the groove, and the edge to the rectum; he now divides the urethra, and propels the knife inwards directly in the median line, cutting the neck of the bladder and prostate, more or less extensively, in correspondence to the opinion formed of the volume of the stone. *Third period.* After this incision is completed, the index finger is to be passed along the staff to examine the size of the opening; if it is sufficiently large the forceps is then introduced and the stone extracted with the necessary precautions; but should the opening be inadequate to permit the calculus to pass readily through it, the forefinger is to be again introduced into the bladder, and on it the probe-pointed bistoury, to enlarge the wound to the requisite size. *Fourth period.* The forceps is then passed upwards into the bladder, and the calculus extracted.

The recto-vesical operation was principally introduced into practice by M. Vacca Berlinghieri, of Pisa, and Sanson of Paris; it has in no instance that I am aware of been performed in these countries. Every practical surgeon is deservedly hostile to it; for, much as M. Vacca states its feasibility of execution, the little risk of haemorrhage attendant on it, the large calculi

that can with facility be extracted by this plan ; it is anything but an operation worthy of selection, as both recto and vesical fistulæ often succeed to it; these M. Vacca regards as very trifling inconveniences ; he overlooks altogether the wound of one or both of the vesicula seminales, or of the vasa deferentia,* where they open into the prostatic part of the urethra, which it is impossible to avoid ;—the lesion of these parts, the scientific, experienced, and venerable Scarpa conceives sufficient to condemn the operation, in which I most heartily concur.†

Third plan. *Bi-lateral or transverse Operation.* The patient being properly secured, and the perinæum fully exposed, a grooved staff is introduced through the urethra into the bladder, and confided to an assistant, who also elevates the scrotum, and stretches the skin of the perinæum. *First period.* The surgeon having depressed the

* In one instance after this operation, an incurable recto-vesical fistula remained. The vesiculæ seminales were divided in such a manner that the seminal fluid was discharged through the rectum during coitus. The Italian inventor of this operation has at length resigned it in favour of what is termed the Median Section : the principle of which consists in incising through the centre of the perinæum, without injuring the rectum. It is liable to the same objections as relate to the lesions of the vasa deferentia and vesiculæ seminales, as his recto-vesical plan.—*Lancet*, vol. i. p. 317. 1828-9. The reader is referred to some cases of the Median Section, by Dr. Bardiini, in the *Revue Medicale*, tom. iii. p. 446, 1828.

† For further information on this operation, read the Memoir of Vacca, translated from the Italian, by Dr. Morin.

anus towards the coccyx with the left hand, makes an incision, commencing about one and a half inch to the right side of the raphè, and extends it to an equal distance to the opposite side of it, curving about one inch anterior to the verge of the anus : the incision is then to be extended a little on each side near the ischium. *Second period.* The forefinger is next inserted into the centre of the incision, to depress still more the anus and rectum towards the coccyx, whilst the operator penetrates through the different tissues situated in the wound, to expose the membranous portion of the urethra posterior to the bulb. *Third period.* The bi-lateral section of the urethra, prostate, and neck of the bladder, may be effected in various ways :—*e.g.* if the ordinary sound is used the handle being turned towards the right side, and properly lateralized ; the scalpel is to be passed along the groove to divide the left segment of the prostate ; by a corresponding manœuvre, the opposite side of the gland is to be incised—or the double and bilateral bistoire caché being set, it is to be passed into the urinary reservoir on the sound, which is then withdrawn ; when the handles of the blades of the bistoire caché are to be pressed towards each other, and drawn gently outwards to the operator, dividing the parts already indicated. The principle of this plan is decidedly taken from the apparatus minor, or the operatio Celsiana. The merit of its invention is claimed for Chaussier,

Beclard, Delpech, and Dupuytren. Advantages of this operation :—the bladder is opened by a more direct and easy route; no important blood-vessel can be wounded, to furnish an alarming haemorrhage; the rectum and vasa deferentia are better protected from injury; finally, a very free and open passage is offered to the introduction of instruments and the extraction of calculi.

This operation, I believe, is exclusively confined to French Surgery: from my own experience, or that of my friends, I can say nothing of it.

LITHOTRITY, OR LITHONTRITY.

However unpleasant the confession may be to the skilful and experienced lithotomist, who deservedly had reason to be proud of his skill, for in what operation is more dexterity and presence of mind requisite than in lithotomy; to dive through the depths of the perinæum without injury to any of the important parts contained in the pelvis, to open extensively the bladder, seize the stone and extract it; still it must be acknowledged that the lithotomic era of surgery is passing away, and a new one succeeding to it,—under the auspices of lithotrihy, which bids fair in a few years to supersede lithotomy, and to consign it almost to oblivion.

I am not too sanguine in my expectations of the triumph of lithotrihy; it is already triumphing, for, in addition to the numerous successful cases published in the Continental Journals, it

has been repeatedly performed in England,* with the most favourable results, also with a similar result in one case by Mr. Liston of Edinburgh,† who I believe is the first regular practitioner that has attempted it in Great Britain. The Continental surgeons have not been deterred from the practice of lithotomy; M. Dupuytren has commenced it, and with success; whose hand it was to be presumed, from the force of habit, could manage no other instruments for the removal of calculi from the bladder, but a staff, knife, and forceps.

Those trials by regular surgeons I hail with satisfaction.

One of the most successful lithotomists of this or any other country, Mr. Crampton, has resigned the knife in favour of the new art, and has recommended patients, who were willing to be incised by him, to the lithotritist (Baron Heurte-loup): their cases are detailed in full in the *Lancet*.

* *Lancet*, vol. i. p. 830, 1829-30; vol. ii. p. 78; Admiral —— Case attended with diseased prostate and bladder. Vol. ii. p. 940—p. 864; Dr. Castle's case—p. 656, attempted by Dupuytren, who failed; lithrotised by Dr. Civiale—p. 240—p. 461; successfully, by Dupuytren. *Archives Gener. de Med.*, April, 1826; Cases by M. Civiale; *Revue Med.* tom. ii. p. 354, 1827, *Memoire on Lithotomy* by him. *Revue Med.* tom. i. p. 253, 1826, *Memoire* by M. Leroy. *Johnson's Med. Chir. Review*, November, 1828; p. 191. *Edin. Med. Surg. Jour.* vol. xxi. p. 223.

† *Medical Gazette*, vol. iii. p. 673.

For some time lithotomy must be still resorted to, for the purpose of extracting calculi of very large size, as they for the present baffle the lithotritic art, which cannot accomplish the destruction of stones beyond one inch and a half in diameter.*

Still it will ultimately yield to lithotritry, for in proportion as the success of the last is more diffused, patients will apply for relief in the very commencement of the disease, when the stone has not acquired such a volume as to be beyond the agency of the lithotritic apparatus.

Hence it is imperative on every surgeon and student to bend their minds to acquire the manipulatory skill, so necessary in this new department of operative surgery, and not to allow some of the most important parts of their profession to be monopolized by itinerant practitioners ; if not, ere long, the lithotritist will assume the same consequence and high bearing that the oculist did formerly, and for a time will lord it over the scientific and dexterous surgeon, who is equally competent to the practice of this operation, as he is for that of any other in the wide domain of surgery.

I hope that surgeons will no longer exhibit indolence or inattention to this discovery, but imitate the example afforded by Messrs. Liston and Dupuytren.

* The only cases in which Lithotritry can be ever considered impracticable, after a time, are in those of calculous concretions deposited on metallic substances, which may be so hard as to resist the action of the lithotritic instruments. Such cases must be very rare.

The different manipulations which professed lithotritists would name, art, skill, legerdemain, &c., should not prevent the practitioner attending to the use of the instruments necessary to file, scoop, and crush, the calculi.

One of the apparent great difficulties in lithotomy, is the introduction of straight or rectilinear instruments through the male urethra into the bladder, and subsequently working them, which cannot be passed without some injury to the sub-pubic portion of the urethra, which is not alone curved, but is also the most fixed part of it; during these attempts, often so much force and traction are requisite to accommodate the urethra to the straight instruments, as to cause rupture of it, sanguineous effusion, urinary infiltration, and death.*

The difficulty arising from the introduction of the rectilinear lithotritors,† is even now being obviated, as curvilinear ones have been made‡ and put to the test; though not as successful as could be wished, what first attempt has ever yet

* Journal Hebdom. tom. iii. p. 195.

† The student is requested to pay attention to the anatomy of the perinæum, as elucidating the facility of the introduction of straight sounds—also to the chapter on catheterism, for the manner of passing these instruments into the bladder, in the subsequent parts of this work.

‡ By Dr. Pravaz, Journal Hebdom. tom. ii. p. 474. See the third volume of the Journal Heb. for the trial of the curvilinear instrument of Dr. Pravaz, by M. Blandin.

answered the purposes of the inventor? still they worked well, and will no doubt be brought to such a state of perfection, as that their manipulation will be equally safe and expeditious as the rectilinear lithotritors.

Baron Heurteloup sometimes uses with great advantage a recto-curvilinear sound, which is perfectly straight to a certain length, with a curved extremity, which represents the quadrant of a circle, the radius of which is an inch and a half.*

It appears from the trials which have been instituted, that lithotrity is a more unsuccessful and arduous operation in the female than the male; principally I believe owing to the greater difficulty experienced in grasping the stone; this at first view seems extraordinary, as in that sex the shortness and dilatability of the urethra, would appear to accommodate any instrument, and permit it to range through every part of the bladder in quest of a calculus. This difference in the operation in the two sexes, is supposed by some to depend upon a peculiarity in the bladder of the female, namely, the neck of which is so very low at its *bas-fond*, that the calculus always lodges on the part and is applied on the opening in the urethra.† It can be

* Lancet, vol. ii. p. 79, 1829-30.

† Johnson's Med. Chir. Review, Dec. 1829, p. 229. In this number the reader will find the review of a Brochure by M. Bancal on Lithotrity.

more correctly attributed to the great transverse extent of the bladder in the female, which admits of a depression on each side of the vagina, forming a kind of cul de sac into which the calculus passes, and cannot be so readily seized, as it escapes into one or other of these sacculi, and so eludes the instrument necessary to grasp it, preparatory to the subsequent stages of the operation. Cannot this difficulty be overcome by the introduction of the finger into the vagina?

Owing to this peculiarity in the bladder, the operations by dilatation and by cutting instruments, as heretofore employed, are more successfully performed in the female, than lithotrity.

LITHOTOMY IN THE FEMALE.

Calculi may be removed from the female bladder, by dilatation of the urethra, or by the use of cutting instruments: the methods by the latter means, allow the operations to be arranged as in the male sex—into simple and compound: the former comprises the high or supra-pubic operation, the lateral, the sub-pubic of M. Dubois and of M. Lisfranc; while the latter offers but one kind in the female, the vagino-vesical operation.

Operation by Dilatation. First plan. The patient being secured, as in the lateral operation, and the surgeon being provided with one of Weiss's dilators, having oiled it, he introduces the instrument cautiously through the urethra

into the bladder, and using extreme care, he proceeds to dilate the urethra and neck of the bladder, to a sufficient extent; he then passes a pair of forceps into the bladder, and extracts the calculus. Surgeons were induced to practise this operation from witnessing the very large calculi discharged from the female bladder through the urethra, without any interference of art.*

Second plan. The enlargement of the urethra has been effected in a more gradual manner, by means of sponge, of different sizes, being introduced into the urinary canal, till it is sufficiently dilated to admit a forceps for the purpose of extracting the stone; as the time required by this method, will occupy at least from eighteen to twenty-four hours, more generally a longer period; it will be necessary to guard against the retention of urine, by passing through the sponges into the bladder a gum elastic catheter, to allow the contents of it to flow off.

In the opinions of surgeons, a great diversity prevails as to the practice by dilatation; some practitioners of great experience, as Scarpa,

* Heister cites many such examples; also Dr. Yellowly has communicated a remarkable case, of a calculus weighing upwards of three ounces, that passed into the urethra, and was extracted with the finger and thumb. He has also collected an historical account of numerous large calculi discharged by women. Med. Chirurg. Trans. vol. vi. p. 582. Sir A. Cooper, vol. xii. p. 235, of the same publication. Thomas, vol. i, in the Med. Chirurg. Transactions.

Klein, and Dupuytren, being hostile to it, at least if the calculus is of any great magnitude, in consequence of the very distressing incontinence of urine that succeeds to it; whilst others assert, that such an affection never ensues so as to continue for any length of time. Sir A. Cooper* expressly states, that great advantage is derived from dilatation, and that incontinence of urine is not caused by it. To meet these contending opinions, the young practitioner should adopt the maxim of "*medio tutissimus ibis;*" and have recourse to dilatation, when the calculus is but small, when little apprehension need be entertained of the neck of the bladder and urethra being so far injured as to give rise to incontinence of any duration.

The methods by incising the bladder, to remove the calculus, are necessary to be adopted, when it is very voluminous; of these, five plans have been invented to permit the surgeon to accomplish his intentions.

The high operation. It is conducted on the same principle as in the male subject, and is less dangerous in the female than in the male, since there is very little probability of infiltration of urine succeeding to it, as it can be prevented by the introduction of a catheter into the bladder.

Lateral operation. The surgeon makes use of a straight and deeply-grooved staff, with any

* Med. Chirurg. Trans. vol. xii. p. 240.

of the other cutting instruments that are required in the opposite sex. *First period.* The patient being secured in a similar manner as for the operation in the male, the labia are to be separated and the staff introduced into the bladder, and the presence of the stone verified; the groove of it is to be then lateralized, by turning it obliquely downwards, at the same time that it is raised to the pubic arch, which separates the urethra from the vagina. *Second period.* The operator then passes his knife along the groove, which is also held in the lateral position, dividing the urethra into the bladder, when a gush of urine flows. *Third period.* He then depresses his hand, withdraws the knife, and cuts obliquely downwards and outwards between the left ramus of the pubes and ischium, and the side of the vagina, so as to make a free opening. *Fourth period.* The finger is then passed into the bladder, on the blunt gorget, which allows the forceps to be carried along it to seize the stone for its extraction.

The advantages of this operation consist in affording a free passage for the extraction of the calculus, without producing the risk of a permanent incontinence of urine: but it is not unattended with some danger during its performance, from the following inadvertencies: the knife, if too much lateralized, may divide the pudic artery, while if the proper degree of lateralization is not given to it, the vagina will be laid open, and vesico-vaginal fistula be produced.

The sub-pubic Operation, as performed by M. DUBOIS. After the patient is placed in the proper position, *first period*, a straight grooved sound is introduced into the urethra, the groove being directed to the symphysis pubis; which is depressed with the left hand, to separate the canal from the pubic arch. *Second period.* The operator then conducts, by the groove, a scalpel, and divides the superior parietes of the urethra, with the neck of the bladder, of sufficient extent to allow the extraction of the calculus. *Third period.* The instruments being withdrawn, the finger is passed into the bladder to examine the size of the wound, and to guide the forceps into it. This operation may be performed with the bistoire caché, without any previous introduction of a staff.

As the soft parts in this situation are very lax and extensible, no impediment is offered to the withdrawal of the forceps charged with the stone: no vessels of any size are wounded by this plan, as none course in the line of the incisions.

Sub-pubic Operation, as performed by M. LISFRANC. *First period.* The patient being situated as in the other sub-pubic operations, and the labia divaricated, the operator introduces an ordinary staff into the urethra, and gives it in charge to an assistant, who presses it gently downwards; and with it the urethra and vagina; the surgeon then examines in the vagina with

the index finger, for the course of the pudic arteries; after which, with a common bistoury, he makes a semilunar incision, beginning on a level with the right side of the urethra, and cuts parallel to the ascending ramus of the pubes, then to the symphysis, and terminates at a corresponding point on the opposite region of the urinary canal; the convexity of this incision looks upwards, and is distant about one line from the bones and symphysis pubis. The handle of the bistoury, when making this incision, should be a little lower than the point, which divides, cautiously, the different layers of tissues till the bladder is exposed. *Second period.* The bladder being exposed, the operator either may plunge his knife into it, and cut that viscus transversely, or he will find it more safe and expeditious, to introduce the thumb of the left hand into the vagina, and the index finger into the wound, when, by drawing gently the tissues held by them, the bladder is stretched, which can be opened either longitudinally or transversely. The longitudinal incision is parallel to the muscular fibres of the bladder, and is distant about sixteen lines, or an inch and a quarter at its superior extremity, from the peritoneum, while the transverse incision is perpendicular to these fibres, and is at a much greater distance from the peritoneum.

The inventor conceives that no danger is incurred of peritoneal inflammation, urinary fis-

tulæ, or incontinence of urine, which too often succeed to the other sub-pubic methods.

Observation. I have occasionally performed this operation in the dead subject, and cannot coincide with M. Lisfranc as to its eligibility, either in the executive part or the extraction of the calculus; the first is effected in a slow and unsatisfactory manner, as the point of the knife can be alone employed to divide the parts; the incisions into the bladder are not guided by any defined course; hence the operator is liable to open the urethra at its point of junction with the bladder, or the canal may be actually cut across, even if the incisions are well directed; the bladder is opened in the narrowest part of the pelvic outlet, so that calculi of any size can scarcely pass through it without considerable dilatation of parts almost incapable of it: it is also necessary to press the neck of the bladder and urethra downward to the vagina in a very forcible manner, to afford space for the extraction of the forceps loaded with the calculus, which will cause not alone contusion, but often very serious laceration.

Compound Operation. The vagino-vesical operation, was first introduced by Rousset, and proposed by M. Mery to be universally adopted for operating on the female.

Operation. The patient being properly secured, the surgeon introduces into the urethra a grooved staff, the groove looking towards the vagina, and into the vagina a slender piece of wood of the shape of a spatula, the extremity of it is then made to press against the beak of the staff

across the vesico-vaginal membranes, whilst the handle is to be depressed against the posterior aspect of the vagina : by this arrangement of the two instruments the parts intended to be divided are clearly exposed, while the spatula, by resting upon the floor of the vagina, completely protects it from the knife. *Second period.* The operator then intrusts the spatula to an assistant, and takes charge of the staff with the left hand, when, with the index finger of the right, he ascertains the groove in it, and the parts which he intends perforating, and penetrates through the vesico-vaginal membranes with the point of a long, narrow-bladed scalpel, till it lodges in the groove ; having satisfied himself on this point, he glides it from before backwards till it is arrested by the spatula, in this manner making an opening of sufficient extent to allow the extraction of the calculus, which is removed in the usual way.

Observation. This plan is very simple in its execution, and admits calculi of the largest size to be extracted by it ; no hæmorrhage occurs during or after its performance, for in fact no vessels of any consequence run in the line of the incisions.

It may be apprehended that the vesico-vaginal wound will not heal kindly, but leave distressing fistulæ—these seldom or ever occur : it may be conceived, that during parturition, the cicatrix would give way, and allow the communication of the two cavities ; this fear appears to be altogether imaginary. We may recommend this plan

as a valuable operation in those cases where the calculi are very large.*

Some observations on the Anatomy of the Perinæum in the Male subject, to explain the surgical operations of this region. The inferior aperture of the pelvis, deprived of all the soft parts, but the sacro-sciatic ligaments, offers to the student's consideration three arches, two of which are lateral and posterior, situated between the coccyx and tuberosities of the ischia; while the third is anterior, bounded laterally by the ischiatic tuberosities, whilst the symphysis pubis forms the top of it. This outlet of the pelvis presents three diameters, viz., the antero-posterior, extending from the apex of the os coccygis to the symphysis pubis, the lateral, stretching between the tuberosities of the ischia, which may be also termed the ischiatic; the third or oblique diameter, passes from about midway between the tuber ischii and arch of the pubes to the centre of the sacro-sciatic ligament of the opposite side: these diameters, in the natural state of the parts, are nearly equal; but, if the coccyx is turned backwards to its fullest range, the antero-posterior diameter, will then exceed each of the other diameters by at least one inch; this is particularly observed in regard to the female pelvis.

The true pelvic cavity is traversed by an imaginary line called the axis, and passes from above downwards, and from before backwards; it does not run parallel with the line that the centre of gravity represents, but crosses it; where these two lines decussate, in the pelvic basin, an angle of about 58° is formed, the sine looking forwards,†

* Sabatier Med. Oper. tom. iv.

† Camper Demonstrationum Anatomico-Pathologicarum, lib. ii.
p. 1. tab. i. fig. 1.

but may be greater or less ; it is always more obtuse in the female than the male ; and in both sexes it can be increased or diminished by varying the relations of the pelvis with the trunk.

If attention be paid to the pelvic axis, it will be found to be situated farther forward in the adult than in the child ; in the latter it runs parallel, or almost coincides with the line of gravity, in consequence of the straightness of the spine in this period of life ; from whence it follows that the pelvis ought to be more elevated in the old than the young subject, when the lateral operation of lithotomy is being performed at these respective ages, as it will tend to make the axis of the pelvis and the line of the centre of gravity to be nearly continuous with each other : it also follows as an axiom from this, that the instruments used in lithotomy to enter the bladder and to extract the calculus, should be made to pass as near as possible to the axis of the pelvis, otherwise the operation will be rendered more difficult and dangerous during the section of the soft parts, and the extraction of the stone.* The capacity of the pelvis is not the same in both sexes, nor in all individuals, as it is influenced by the strength and stature, also by affections of the spine, and even by

* It is scarcely possible to press upon the student's attention in too forcible a manner, the necessity of obtaining clear and precise ideas of the relations of the axis of the pelvis and of the body to each other ; how they can be altered by change in position of these respective parts, and by disease ; as on the accuracy of this knowledge depends much of his success in lithotomy, in catheterism, and in affording assistance to the female during parturition : since the introduction of lithotripsy as a remedial measure for urinary calculi, this information is doubly important.

old unreduced luxations of the femur ; but the capacity differs principally in consequence of age ; in infancy neither possessing the depth nor breadth that it has in advanced life, also containing less of the pelvic viscera in the former than the latter period. In those recently born, the bladder ascends above the pubes, whilst in adults, it is completely buried in the pelvic cavity beneath these bones. Between the fourth and fifth year after birth, when moderately distended, the bladder is placed below the superior margin of the pelvis ; an acquaintance with those varieties in the relations of the pelvic organs, is of importance in many surgical operations, as lithotomy, paracentesis vesicæ, &c.

The perinæum in the recent state, and when arranged for dissection, may be compared to an oval figure, or to that of a lozenge ; the longest diameter of both being from before backwards ; if it is considered to resemble the latter figure, there will be then an anterior and a posterior angle, and two lateral ones : by drawing a line from one ischiatic tuberosity to the other, this space is divided into the perinæum, properly so called, and into the anal region.

The perinæum will now be seen to form an equilateral triangle, the base at the ischiatic line, and the apex at the symphysis pubis ; which can be divided into two triangles of equal area, by letting fall a line from the symphysis pubis perpendicular to and on the centre of the one that extends from one ischium to the other ; the sides of these triangles are about three inches long ; however, the external side may exceed the internal by half an inch, owing to the curved course formed by the rami of the ischium and pubes, that bound part of the inferior

outlet; the bases are equal, being one and a half inch in length. The left triangular space, is the one, in which ordinarily the lateral operation for lithotomy is performed.

First layer of parts in the dissection of the Perinæum. Before the integuments are removed, the mesial-line of the perinæum is indicated, by a slight cutaneous elevation, that can be traced as being extended along the inferior surface of the penis, over the scrotum, as far back as the anus, where it terminates: this line is named the raphè, and points out the union of the skin from the lateral halves of the body.

In a surgical point of view, the existence of the raphè is important, as it indicates the position of the septum scrotri and the course of the urethra in perinæo, it also serves as the most certain guide to find the latter, in cases where it is necessary to seek for it, when ruptured; as the incisions, if made through the centre of the raphè, will with more certainty conduct the operator to the ruptured part of the urethra, than if they are made on either side of it.

When the skin is removed from this region, it is observed to be very thin and highly vascular, and covers a quantity of cellular tissue traversed by numerous small blood vessels; the removal of these tegumentary coverings exposes the superficial fascia of the perinæum, also the superficial sphincter ani m., which arises posteriorly from a ligament named the ano-coccygeal, then passes forwards surrounding the anus, and is inserted by a pointed termination, into the centre of the perinæum, and superficial to the fascia superficialis; this muscle is of an oval shape, presenting a cutaneous and pelvic surface, an internal and an external edge, some of its most ex-

ternal fibres are said to be liable to be cut in the lateral operation of lithotomy ; this but seldom occurs, since the muscle in the living subject does not present the flaccid and expanded appearance that it does in the dead.

A few words may be permitted on a peculiar affection of this muscle, which has been principally brought under the cognizance of the profession by Baron Boyer,* he names it "fissure" or "cracks," which can only be perceived by a careful examination of the verge of the anus ; every time that the sphincter is brought into action, the patient experiences most excruciating pain, which nothing can alleviate ; he describes it of so aggravated a nature, that the invalid dreads the idea of an alvine evacuation : M. Boyer admits the propriety of injections of cold water, when they can be borne as a palliative measure, if not, cold aspersions against the anus may be used with the same intention. The permanent mode of relief is to divide the muscle, by which it is paralyzed for a time, and before the incision heals, the disease is completely remedied ; in order to effect this, the index finger of the left hand, well oiled, is to be introduced in *ano*, also a narrow scalpel lying flat on the finger, with the edge partly buried in it ; after it has fully entered the anus, the edge is to be turned outwards and the muscle cut across : the best direction to give the knife, is towards the tuber ischii, by which the sphincter will be cut transverse to its fibres, consequently more completely paralyzed, and no danger of wounding important parts incurred ; while, on the contrary, if the incision is for-

* Journal Complementaire du Dictionnaire des Sciences Medicales.

wards, there is some risk incurred of implicating the bulb of the urethra, while the muscular fibres will not be so perfectly divided as when the lateral section is made; the latter objection holds if the posterior part of the muscle is selected for the operation.

Second layer. The superficial fascia of the perineum will next claim every attention from the student, who will examine it, by making an incision into it parallel to the urethra, and dissect the fascia from the subjacent parts. It can be easily removed from them till he arrives at the ischia, to which it is intimately united, and from whence it can be traced continuous with the superficial fascia on the posterior part of the thighs. When this membrane is examined posteriorly, it sends a process inwards to unite with the posterior edge of the triangular ligament of the urethra, and furnishes another that extends into the anal region, which can be traced upwards through it, to cover the inferior or cutaneous surface of the levator ani, as high as the origin of that muscle, from the angle formed by the junction of the pelvic and obturator fascia. Between the levator ani, the obturator fascia, and the skin inferiorly, a triangular cavity is circumscribed, containing a considerable quantity of adipose membrane, also the external haemorrhoidal vessels, derived from the internal pudic, which penetrate the obturator fascia to arrive at the rectum. This cavity is frequently the seat of extensive abscesses, characterised by the great fætor of their contents, which demand an early and a free opening; if the superficial incisions in the lateral operation are carried too far back into this region, the external haemorrhoidal vessels are endangered.

Anteriorly the superficial fascia is continuous with

that of the scrotum and penis, also of the abdomen, constituting but one and the same membranous expansion, and is so loosely attached to the subjacent structures in these regions, as to afford an easy explanation to pathological phenomena of frequent occurrence ; namely, the course that urine takes when extravasated in the perinæum, in consequence of rupture of the urethra, when if timely assistance be not afforded to the patient, it is observed to pass forward, distending the cellular membrane of the scrotum, thence to the penis ; after having filtrated the superficial cellular tissues of this organ, the urine ascends above the pubes, and in some instances even to the umbilicus ; whilst it is impossible for the urine to descend at the back of the thighs, or to the lateral parts of the anal region, owing to the intimate adhesion of the superficial fascia to the ischia, and triangular ligament. The density of this membrane will not allow the urine to point in perinæo ; a slight elevation or fullness of the parts, with an emphysematous or crackling sensation, some discoloration of the skin, and some cedema, are the principal local symptoms attendant on such an affection ; often large abscesses form in this region, and seldom point in the evident manner that they do in other situations, the reason of which is obvious.

A knowledge of these facts, derived from the anatomy of the fascia in question, lead to the necessity of early and free incisions into the perinæum when urine is extravasated into it ; not alone to give exit to the urine, but to prevent the destructive effects of this fluid on the cellular tissue that invariably attend it, which, if neglected, will be positively followed by inflammation of the skin and sloughing, forming ulcers of considerable

size, which, in many cases, are very difficult of cicatrization ; the same practice is called for when matter collects in this region.

Third layer. After the superficial fascia is removed, and the cellular membrane beneath it cleared away, which sometimes presents the appearance of a fine fascia, the following parts become visible; at the sides, and running parallel to the rami of the ischium and pubes are the *erectores penis* muscles, covering their respective crura ; in the centre of the perinæum the *accelerator urinæ* presents itself, which is separated from the *erector penis*, on each side by a narrow triangular slit, containing some cellular membrane : the student ought carefully to observe the bearings of this space to the sides of the perinæum, to the centre of it, also to the pubic arch as it is towards the posterior part of this region, and between the muscles now mentioned, that he is to enter his knife in the lateral operation of lithotomy when attempting to penetrate into the membranous portion of the urethra ; it is also through the posterior part of it that he is to pass his trochar, when the operation of tapping the bladder by the perinæal method is attempted : the *transversales perinæi* muscles extend from the *tubera ischii* inwards and forwards, to the centre of this region, and form a subtending line to the perinæum, which divides it from the anal ; posterior to them some of the middle fibres of the *levator ani* muscle are perceived descending from the pelvis, and lie behind the *accelerator urinæ* and the anterior part of the rectum. In this stage of the dissection the only artery visible is the *transvers. perinæi* ; after being given off from the pudic, it becomes superficial either by passing posterior to the muscle of the same

name, or by penetrating between some of its fibres, and sends its principal branches forwards to supply the scrotum and integuments in that situation; almost an inch and a half posterior to the transvers. perinæi artery, the inferior or external hæmorrhoidal will be found to penetrate the obturator fascia, and crosses about the middle of the anal region to supply the parts at the verge of the anus.

Before proceeding further in the dissection, the student ought to examine what parts must be wounded in the different operations for lithotomy performed in the perineal space, properly so called:—for example, 1st, he will perceive that the great object to be attained in the lateral operation, is to enter the space between the accelerator urinæ and erector penis muscles, without any lesion to either of them; though he avoids these, it will be impossible to preserve the transversalis muscle and artery, they consequently must be sacrificed: 2nd, the operatio minor or Celsiana, will implicate a small part of the accelerator urinæ; 3rd, and by the Marian mode, or the operatio major, the accelerator muscle will be partly cut, and partly lacerated for the whole of its length.

Fourth layer. It will now be necessary to make an incision through the centre of the accelerator urinæ, parallel to the urethra, and detach it carefully from both the urethra and bulb, which it envelopes; the transversus perinæi muscle is also to be removed, and the cellular membrane from both the perineal and anal regions; the bulb of the urethra is now seen, of a dark venous colour, hanging or projecting towards the anus. The student can scarcely devote too much time to obtain a correct and intimate knowledge of the relations of this part of the urethra, to the arch of the pubes, to the rectum, and to

the anus ; also to the triangular ligament of the urethra, named by some the middle perinæal fascia, and by others the deep perinæal fascia.

The perinæal fascia or triangular ligament of the Urethra. To see the attachments of the triangular ligament of the urethra, to comprehend its uses, and the pathological phenomena dependent on it ; it is necessary to remove the crus and erector penis of one side, allowing them to remain on the opposite ; the urethra is also to be cut across about an inch anterior to the bulb, and dissected from the penis ; the ligament is then seen to arise from a small part of the ascending ramus of the ischium, and from the descending one of the pubes, on the pelvic side of the crus penis ; from these origins it stretches across the perinæum, and is inserted into corresponding points on the opposite side ; the apex of the triangular ligament reaches as high as the base of the pubic or sub-pubic ligament, (which strengthens the union of the pubic bones at the symphysis, being of a fibro-cartilaginous structure, and is about half an inch deep,) where it is often very thin ; in the space between them, the venæ magnæ penis and deep lymphatics of the organ pass into the pelvis : from the apex the ligament extends backwards, for about one or one and a half inch, closing up for this space the anterior and inferior part of the pelvic aperture ; but allows a foramen in the centre to transmit the membranous part of the urethra, which then becomes surrounded by the corpus spongiosum, when it forms the bulb ; a process of fascia is sent from the anterior layer of the triangular ligament over the bulb, and confines it in its situation, giving also to it a shining appearance. Posteriorly by its concave edge or

base, the perineal fascia corresponds to the transversalis perinæi muscles, and is attached to the rectum; underneath this edge a large plexus of veins extend along the prostate gland, to communicate with the large vesical veins placed about the neck and inferior fundus of the bladder: this venous net-work is most apparent in old people, and when opened in lithotomy, affords for a time a copious haemorrhage.

The lateral edges of the triangular fascia or ligament, can be seen to be continuous with the obturator fascia on each side, which may be proved by examining close to the rami of the pubes and ischium, from which the erector penis muscle and crus of that organ have been detached, when their continuity will be immediately apparent; the part of this ligament which must be sacrificed in *lithotomy*, is that which extends posterior to the bulb, and is partially cut into, as the operator enters the membranous part of the urethra, and the division completed as the knife is being withdrawn from the bladder. It will be also seen in this view of the parts, that some of the anterior and middle fibres of the levator ani muscles, will also be divided as the knife is cutting from within outwards.

The strength of the perineal fascia can be easily proved by the following rude trials: if the finger is pressed on either side of the bulb, it is prevented sinking into the pelvis, by the resistance afforded by this membrane; if anterior to it or between the bulb and pubic ligament, it is also prevented penetrating into that cavity, owing to impediments afforded not alone by the part of the ligament situated in this place, but principally by the fibro-cartilaginous structure of the sub-pu-

bic ligament ; while with a little force, the finger can be made to sink into the pelvis, when the attempt is made posterior to the bulb, where the ligament is weakest.

The bulb of the urethra, which lies on the inferior or cutaneous surface of the triangular ligament, is distant about one or one and a quarter inch from the angle of the pubes, (*Colles,*) whilst it is removed from the anus by a space equal to one inch ; it receives on each side a short and full sized trunk, sent from the internal pudic as it runs on the pelvic surface of the erector and crus penis ; this vessel is from half to one inch anterior to the transversalis perinæi artery ; being both deeper seated and larger than it, supplying the spongy portion of the urethra with blood.

Some attention is requisite to avoid wounding this artery, in the lateral operation, or serious hæmorrhage may be the result ; the best way to prevent such an occurrence, is not to cut into the bulb, but to lay bare the staff posterior to it, if possible at the point where the membranous portion terminates in the bulbous part of the urethra. On each side of the bulb, and covered by the anterior lamina of the triangular ligament of the urethra, is a small gland about the size of a garden pea, from each a small duct, one inch in length, passes forwards to open into the urethra ; these are the anti-prostatic or Cowper's glands.

Fifth layer. To the bulbous portion of the urethra succeeds the membranous, extending from it to the prostate gland ; it is retained in situ by the triangular ligament of the urethra, which sends a process back on it to the prostate gland, to which it gives a strong capsule, it is also supported by what are named Wilson's muscles,

or the most anterior fibres of the levator ani; they are also called the compressores urethræ (*Bell.*) The length of the membranous part of the urethræ is about one inch; when examined in the detached state, the superior part appears a little longer than the inferior, owing to the apex of the prostate gland being extended a little farther on this aspect. This part of the urethra is placed about ten or twelve lines, or one inch, beneath the arch of the pubes, and nearly in close apposition to the rectum. It may be allowed to ask the question, does the membranous portion of the urethra run a perfectly straight course, or is it curved? The testimony of all the anatomists that I have examined, and from repeated dissections made by myself to ascertain this point, prove it to be slightly curved, the concavity looking to the pubes and the convexity to the rectum; opposed to this opinion is M. Amussat,* who strongly contends that the urethra is perfectly straight in this part of its course; in fact, he compares it to that of the female; it is evident he forgets the difference in the depth of the arch of the pubes in the two sexes; in consequence of its being greater in the male it will render that part of the urethra under consideration more curved in man than in woman. I have even made frequent dissections, in the manner recommended by this gentleman to investigate this question, but still the curve in the sub-pubic part of the urethra cannot be completely obliterated, whatever position is given to the

* Archives Gen. de Medecine, tom. iv. pp. 31-547, for his interesting memoir.

penis; if it be held at right angles to the abdominal parietes, and even depressed between the thighs, the position necessary for the successful introduction of straight instruments, the curve still remains, and the mucous membrane of the floor of this part of the urethra is thrown into folds or plicæ.

M. Amussat is particularly anxious to establish a straight canal in this part of the urethra, as he is one of the strongest advocates for the greater facility that exists of introducing *straight instruments* into the bladder, in preference to those that are curved; from what has been already said, it appears to me he strains this point to support his opinions.

However I may differ from that gentleman as to the course of the urethra in this place, I fully agree with him, that it can be rendered almost straight by elongating the penis and keeping it in the position already described, which will allow a straight instrument to be introduced into the bladder; this I have often exhibited to my class on the dead subject, and have satisfied myself of it in the living.

The structure of this part of the urethra is named membranous, from its generally supposed thin texture; in the paper above alluded to, the reader will find some very ingenious opinions of M. Amussat to prove its muscularity, which is, in fact, a revival of the opinion of the earlier anatomists, who maintained that it was also muscular.

It has been now seen what services are rendered by the triangular ligament, or perineal fascia in the normal or natural state of the parts; the situation of the bulb, and the course of the membranous portion of the

urethra, are also comprehended ; it is consequently the fit period for the student to examine how these parts are likely to interfere with catheterism, always a delicate operation ; if he draws the urethra outwards towards himself, he will perceive that the foramen in the peri-næal fascia which admits the urethra through it, is but sufficient for that canal, while it is proper for him to re-collect, that the calibre of the urethra enlarges in the bulb immediately after it has escaped from the opening in the ligament ; he will also observe, that the part of the urethra placed in the foramen is fixed, whilst that anterior to it, is capable of much motion ; in the flaccid state of the penis there is an angle formed immediately anterior to it, the sine regarding the rectum ; however, this cannot be any impediment to the operation of catheterism, as it is easily destroyed by drawing the penis downwards. From such a relation of the parts and organization, it is evident to the student, that the most difficult point in passing a curved catheter is to propel the beak precisely through the centre of the opening into the triangular ligament ; if he swerves from this direction, he will be positively astray, and he must re-trace his steps, *e. g.* if the point is directed to either side, he will force it against the lateral part of the ligament ; if the handle of the instrument is too soon depressed, the point of it will be superior to the foramen he wishes to enter ; finally, if the handle is not depressed in sufficient time, the beak of the instrument lodges in the sinus corresponding to the bulb : if in place of repeating his attempts he forces onwards his catheter, in the three first cases the urethra will be considerably contused, and blood may flow from it, whilst in

the last, he will penetrate through the bulbous portion, and run his instrument between the rectum and bladder. It is also expedient for the student to examine the effects produced on the sub-pubic part of the urethra, by varying the relations of the axis of the pelvis with that of the body, when it will be most evident to him, the more that they are made to coincide by raising the pelvis, or flexing anteriorly the lumbar portion of the spinal column, the nearer to a straight line will the urethra run from the orifice to the bladder.* An acquaintance with these peculiarities, will be of more service to the student in fitting him for passing instruments into the bladder, than what he can derive from adopting any particular curve; to it also will he be indebted for the facility of introducing perfectly straight sounds.

Immediately posterior to the membranous part of the canal, the prostate gland is situated, filling up the arch of the pubes; in form it resembles a chestnut, the base being posterior, embracing the neck of the bladder and the terminations of the vesiculae seminales, with the vasa deferentia.

The gland is retained in its place by some of the anterior fibres of the levator ani, which descend along its external side; it is also intimately connected to the symphysis pubis by the anterior ligaments of the bladder, which is continuous with the internal lamina of the triangular ligament of the urethra; inferiorly the gland

* The rectangular bed used by lithotritists, effects this purpose in the most desirable manner in the living subject. See Lancet vol. ii. p. 79, 1829-30, for the description of this bed.

lies on the rectum, and in those advanced in life it is imbedded in that intestine. In young children the prostate is very small, in the adult it is fully developed, and is from thirteen to fifteen lines long, or almost one inch and a quarter; from thirteen to fourteen broad at the base, or something more than one inch, and is nearly nine lines or three quarters of an inch deep: the axis of the prostate gland is almost horizontal, but is inclined a little downwards and forwards.

This organ admits of what is termed the prostatic part of the urethra to pass through it, which is from twelve to eighteen lines long, and runs more towards the superior than the inferior surface of it; in some few cases none of the gland is above the canal; the vasa deferentia, vesiculæ seminales, and prostatic ducts, open into this part of the urethra, on each side of a projection of the mucous membrane, named the verumontanum; which is placed in the mesial line of the floor of the canal; at the anterior end of this fold a little fossa is situated, named the sinus pocularis, and is sometimes sufficiently large to admit the points of small instruments to hitch in it, and thus cause some delay in their passage into the bladder; on each side of the verumontanum, occasionally the urethra presents a well-defined fossa, both of which are free anteriorly, and generally posteriorly; however, they are sometimes circumscribed in the latter direction, by a transverse fold of mucous membrane, that projects into the vesical end of the urethra, on a line with the base of the prostate; to this lunated fold M. Amussat* has given the name of the *pyloric valve*, and asserts that muscular

* Archives Gen. de Medecine, tom. iv. p. 550.

fibres enter into its composition, which act as a complete sphincter of the bladder: if it was destined for this purpose, both the fold of membrane, and the muscular fibres, would be more frequently found than is the case; however, when it exists, the introduction of a catheter into the bladder will be arrested by it.

As this projection of mucous membrane is more frequently met with in the old than the young subject, it appears to me to owe its existence to the incipient development of the third prostatic lobe, which is situated in the angle formed by the junction of the lateral lobes of the prostate; when small, it is simply indicated by this process of the lining membrane of the urethra; if larger, it then presents a more evident and better defined appearance, and projects from below upwards into the urethra, occluding it more or less, and impedes the entrance of instruments into the bladder.

The urethra, at its entrance and exit to and from the prostate, is narrower than in the centre; still, by a gentle trial, the little finger can be introduced from the bladder into this part of the canal, which establishes for it considerable dilatation, and readily accounts for tolerably sized calculi being found in the urethra; without this capability of yielding to distention, the late investigations instituted by Civiale, Leroy, and others, to extract calculi from the bladder by the urethra would be impracticable.

The structure of the prostate gland, is enveloped by a very dense fibrous capsule, and presents great resistance to the knife, so much so, that it is more liable to be driven before it than divided; hence it ought to be cut boldly into as recommended by Cheselden; though possessed of so much resistance, it can be easily lacerated, and *evenly*,

in certain directions, which may serve some good purpose when large calculi are about being extracted. From experiments instituted on the dead subject, if a small incision be made in it, the gland may be easily lacerated in a longitudinal direction, *i. e.* from the urethra to the ureter; but if cut transversely, and then lacerated, it will yield, but in a very irregular and uneven manner.* I have satisfied myself of the truth of this circumstance, and conceive that it will be more satisfactory when the lateral operation is performed; if the prostate gland is not sufficiently divided in the first attempt, to pass the index finger of the right hand into the wound, apply the point against the staff, and then press the side of the finger against the gland, when it will readily give way in the direction it ought to have been divided in, in the first instance: this manœuvre is preferable, in my opinion, to making a second section, which is sometimes done; the consequence of the latter is that the gland is unequally divided, and in such a manner that a pedunculated portion projects into the bladder, and continues all the symptoms of stone† even after the calculus is extracted. Owing to the difference in size between the prostate gland in the young and old subject, it will be divided for the entire of its length in the former, whilst in the latter, it may not be necessary to make so free a division, when the wound will be sufficiently large to allow the calculus to be extracted: but if the stone be of a large size, it then becomes imperative on the operator to lay it open for the whole of its extent, to allow an easy extraction,

* Camper Demonstrationum Anatomico-Pathol. lib. ii. p. 11.

† Cooper's Lectures, by Tyrrell, vol. ii.

otherwise laceration will attend this step of the operation. We find it inculcated by some,* not to divide this body from apex to base, in order that the formation of urinary and purulent abscesses may be avoided, which they say will undoubtedly follow if this is done; such advice from these writers astonished me, as it is acknowledged by all surgeons of much experience, that the safety of the patient mainly depends on free and large incisions to obviate any laceration whatever; in children the prostate is so small that it must be divided from apex to base, still seldom any of the unpleasant symptoms mentioned by MM. Scarpa and Velpeau supervene: I have seen calculi of such a size extracted from the adult, as to leave no doubt on my mind of the gland being divided for the entire of its length. I shall never forget the manner in which that excellent lithotomist, the late Professor Dease, of the College of Surgeons, inculcated the full section of this body, if it was intended to afford the patient the best chance of success. I apprehend that the fears of MM. Scarpa and Velpeau are more imaginary than real.

As has been already mentioned, the prostate surrounds the neck of the bladder, which is continuous with the inferior fundus of that viscus, the internal surface of these parts present a triangular space, the "trigone," the apex of which is at the orifice of the urethra, where often is observed a slight elevation named the "leuette;" occasionally the inferior fundus forms a deep sacculus projecting to the rectum.

On the external surface of this part of the bladder,

* Scarpa, Memoire on the cutting Gorget, p. 7.—Velpeau Anat. Chirurg. vol. ii,

we observe the vesiculæ seminales and vasa deferentia, extending outwards and backwards, from the prostate gland for the distance of two inches; they lie upon the rectum, and are connected to it by cellular membrane.

By drawing a line from the end of the vesicula of one side to the opposite, a triangle is formed, the sides and base of which are nearly equal; this portion of the bladder rests upon the rectum, being separated from it merely by cellular membrane and some veins; in the natural state of the parts the peritoneum, as it is reflected from the posterior surface of the bladder to the anterior one of the rectum, can be considered also as the posterior boundary of this triangle; the relations of this part of the bladder to the rectum and peritoneum, the student ought to be particularly acquainted with; since it is through it the bladder is opened in the recto-vesical operation, either in lithotomy, or tapping in cases of retention of urine; he will instantly see if the instrument be carried further back than the reflection of the serous membrane, its cavity will be entered and death inevitably ensue.

To perform the recto-vesical paracentesis vesicæ with anatomical correctness, the student ought to remark the relations of the prostate gland to the anus, to the rectum, the vesiculæ seminales and vasa deferentia, also to the peritoneum; he should also take into account its distance from some of those parts, and its length; the apex of the gland is situated about two and a half inches from the anus, then allowing one inch at least from apex to base, it will give three and a half inches for the trochar to pass into the rectum, before it can with safety penetrate the inferior fundus of the bladder:

and to divide the parts in the operation for lithotomy just alluded to, unless the knife is maintained directly in the median line, one or other of the vas deferens will be wounded, and the testicle of that side rendered useless: in this operation it is next to impossible to avoid injuring these ducts. Vacca Berlinghieri, the proposer of this mode, considers such an occurrence a mere trifle; however he may estimate it, in every reflecting mind it will be sufficient to reject such an operation.

From the anus, the rectum ascends into the pelvic cavity, not in a straight course, but forms some curves which it is necessary to be acquainted with, particularly in the male subject, in order to introduce instruments into its interior with ease and safety to the patient: it 1st, passes from the anus upwards, and a little forwards for about two inches, till it arrives as high as the prostate gland: 2nd, it then runs backwards and upwards between the inferior fundus of the bladder and sacrum, to be continued into the large intestines, in this manner presenting two curves of unequal extent: the concavity of the inferior and small one looks backwards to the coccyx; while that of the superior and large one is directed forwards, and contains in it the prostate gland, inferior fundus of the bladder, with the vesiculæ seminales and vasa deferentia.

Hence it follows, when a bougie or any other instrument is being introduced into the rectum, it should first be passed upwards and a little forwards for about two inches, then be directed upwards and backwards. A spiral motion being at the same time communicated to it, by turning it between the fingers, by which the instrument will more easily glide into the intestine, and not-

be arrested by the valvular folds formed by the lining membrane of the gut,* than if it was passed directly into it, and without such a manœuvre. The rectum, for the inferior part of its course, is in intimate connexion with all the parts interested in lithotomy, consequently demands that the student should be well informed of all its anatomical relations.

This portion of the intestinal canal is always much dilated in old people, and but seldom in the young; the alteration in calibre impresses the precaution of ascertaining its size before the operation for lithotomy is performed.

It may not be uninteresting, to recapitulate the different layers of parts, both at the sides and in the area of the triangle, which have been considered in detail; as it will place them before the student in a more connected point of view, by which their relations can be better comprehended.

On the median line of the perinæum, runs the raphè, subjacent to it the superficial fascia, then the white line indicating the separation between the acceleratores urinæ muscles of opposite sides, a little posterior to it the termination of the superficial sphincter ani appears, subjacent to the accelerator is the corpus spongiosum; the bulb now is seen, then the glands of Cowper, resting in the triangular ligament of the urethra; to the bulb succeeds the membranous portion which conducts us to the prostate; finally, the neck of the bladder, and the viscus itself,

* Dublin Hospital Reports, vol. v. Mr. Houston's paper on the spiral and valvular arrangement of the mucous membrane of the rectum.

close the consideration of those parts which lie on the anterior part of the median line; whilst the posterior portion gives the rectum for the entire of its course.

On the external side, subjacent to the skin, some fat exists of greater or less depth; then the attachment of the superficial fascia to the rami of the ischium and pubes; posterior to those and nearly on the same plane, the transversalis perinæi artery and nerves pass inwards; deeper seated are the erector penis, the crus of that organ, the artery of the bulb, the internal pudic artery and nerves, the attachment of the triangular ligament to the branches of the pubes and ischium; finally, the side of the bladder presents itself.

At the base, beneath the skin, are the anterior extremity of the superficial sphincter ani, the terminations of the external haemorrhoidal artery, and from this point to the bladder the rectum ascends; at the external side of the base line, a large quantity of adipose substance, penetrated by small veins and arteries, fills up this part of the perinæal region.

The area of the triangle exhibits the following layers of parts, till we arrive at the bladder; underneath the skin the superficial fascia extends across this space, and some fat varying in thickness, in which are found the transversalis perinæi artery and nerves, also in it we observe the transversus perinæi muscle, the white cellular line separating the accelerator urinæ from the erector penis, the course of the artery of the bulb, some of the middle fibres of the levator ani, numerous filaments of nerves and vessels, deeper placed is a large venous plexus; whilst the bladder and a small part of the prostate gland, situated at the apex of this triangular pyramid, terminate it.

It is a matter of no small importance to those who undertake operations in the perinæum, to be acquainted with the average distance of the tubera ischiorum from each other, also of the comparative depth or thickness of the parts, from the skin to the neck of the bladder. By measurements taken from within the tuberosities of the ischium, M. Dupuytren* found on twenty adult subjects, that the average distance was from two, to three and a half inches: the thickness or depth of this region, gave for the same number of subjects from one inch and some lines, to four inches, the average depth being two and one quarter inches. M. Velpeau† on forty subjects, has corroborated the measurement of the depth of the perinæum, as ascertained by M. Dupuytren; but found the distance between the tuberosities of the ischium, to be from one and three quarters of an inch to four. Such varieties of formation, will, as M. Dupuytren justly remarks, compel the operator sometimes to make his incisions very oblique, at others parallel to the raphè, either to avoid the rectum or the pudic artery; also by the knowledge of the variety in the depth of these parts, he will be able to apply to the knife force proportioned to their presumed thickness, on the one hand not to pass beyond the bladder, on the other he will not from timidity arrest its progress, before it has arrived at this viscus.

* Dupuytren's Thèse.

† Velpeau Anat. Chir. vol. ii. p. 326. It is necessary to remark, that the French inch is a fraction longer than the English.

CHAPTER X.

CATHETERISM.

By this term is understood, the introduction by the urethra into the bladder, of metallic instruments, whether solid, (sounds,) or hollow, (catheters,)—also gum elastic catheters, and gum elastic and catgut bougies.

It is an operation that often demands considerable skill and address, always a full and complete knowledge of the anatomy of the urethra—its course, its curves, its natural contractions and dilatations, also their situations ; the relations of this canal to the surrounding parts ; how these may be affected by change in position of the patient from the erect to the horizontal ; by the propulsion of instruments through the canal of the urethra ; or by traction exerted on the penis ; or by varying the relations between the pelvis and spine. The student should be well acquainted with the *natural difficulties* of this operation, before he can, with satisfaction to himself, undertake it in the diseased conditions of the urethra. It is scarcely necessary to observe, that

it is an operation far more difficult and frequent in the male than in the female.

The affections for which catheterism is resorted to are very numerous :—*1st*, to afford a diagnosis in cases of stricture, also to confirm the presence of calculi in the bladder or urethra: *2nd*, to give exit to the contents of the bladder, generally of urine, sometimes of blood, more rarely of pus: *3rd*, to guide the cutting instruments in lithotomy, and in removing callous and strictured portions of the urethra: *4th*, to prevent urinary infiltration, as in cases of ruptured urethra, caused by falls on the perinæum, or from any other accident, and in perinæal fistulæ: *5th*, to admit of injections into the bladder to allay irritation, and to distend it, preparatory to lithotomy and lithotripsy: *6th*, to remove such affections of the testicle as depend upon an irritable state of the urethra—(*Ramsden*), after other therapeutic agents have failed: *7th*, in some cases, to relieve the irritable state of that canal: *8th*, to command haemorrhage from the urethra.

The choice of the instrument in this operation is by no means a matter of indifference, as much depends on it for the quick relief of the affection that requires its introduction, and for the information of the surgeon; *e. g.* when a calculus is suspected to be present in the bladder, some prefer a solid metallic sound, which they conceive is the best adapted for conveying the sensation communicated by its striking against the calculus; others give the selection to hollow

metallic instruments, which are more light and manageable : the symptom arising from the collision of the hard bodies against each other, they impart equally well as the solid ones, and they possess the advantage of allowing the urine to pass through them, which often brings a small and light stone forwards, to strike against them, and thus inform the surgeon of its presence in the bladder, which could not occur if a solid instrument was used.

When it is intended to evacuate the urine, as full a sized catheter is required as the urethra will admit ; and if blood is present, it must not alone be full-sized, but longer by four or five inches than those usually employed : in old people a large instrument is also necessary, as it develops the calibre of the urethra, the parietes of which, at this time of life, are soft and flaccid ; in retention of urine in old people, the bladder frequently ascends above the pubes, and elongates the urethra; which, consequently, demands a catheter somewhat longer than those in ordinary use.

The curvature of the catheter must be proportioned to that of the urethra, or at least in relation to the period of life ; which is increasing from infancy to old age, being greater in the adult than in the infant, while the urethra is most curved in those who are far advanced in life, which is caused by the increase in depth of the symphysis pubis.

The possibility of passing catheters of different curvatures in the same individual and at the same period of life, leads to the division of catheterism when effected—*1st*, by curved instruments, *2nd*, by instruments perfectly straight.

Operation with the curved or curvilinear instruments. The natural impediments to the introduction of instruments into the urethra, exist either in the interior of the canal,—or depend upon the different curves of the penis;—as connected with the first, it may be observed, that they are chiefly, if not solely, to be met with on the floor of the canal, and are as follows:—*1st*, a very small orifice: *2nd*, the depression of the fossa navicularis, placed at a short distance from the external orifice: *3rd*, the different openings of the lacunæ, all of which look forwards: *4th*, the fossa, corresponding to the situation of the bulb: *5th*, the *contraction* of the canal at the point of union between the membranous and bulbous portions: *6th*, the sinus pocularis: and *7th*, according to M. Amussat, the fossa on each side of the verumontanum, and the pyloric valve, see page 409. In order to avoid these obstacles, it must be held as a general rule, that the beak of the instrument should be constantly applied to the roof of the urethra; for the mucous lacunæ that are situated in this part of its course, though larger than those on the floor, cannot amount to any consideration as opposing catheterism.

The difficulties dependant upon the curves of

the penis are of but trifling consequence in this operation, since they can be so far obliterated, as almost to be effaced: 1st, by holding the penis at an angle of 45° with the abdomen: 2nd, then to depress it to a right angle: 3rd, and finally, by a further depression, between the thighs, so as to form a large obtuse angle, the sine presenting anteriorly, the urethra may be considered as being perfectly straight. These natural obstacles present themselves in both the dead and the living subject; in the latter a third impediment must be borne in mind, namely, that which is due to the tonicity of the canal, also to muscular action and spasm; it is encountered in the vicinity of the accelerator urinæ, of Wilson's muscles, and of the sphincter vesicæ muscle.

Operation. The proper catheter being selected, the surgeon warms it either by friction between his fingers, or by holding it before the fire, for the purpose of removing the unpleasant impression of cold, being superadded to the introduction of such an instrument into the urethra. *First period.* The catheter being well oiled, the patient stands with his back against the wall or a table, or he may lie in the horizontal position, which is preferable to the former, with the legs and thighs flexed, and slightly separated; while the surgeon stands on the left side, and takes hold of the lateral surfaces of the penis near to the glans, between the thumb and two first fingers of the left hand, and draws back the prepuce sufficiently to expose the orifice of the ure-

thra ; the right hand, armed with the sound or catheter, which is held lightly, passes the point of it into the urethra, guided by the index finger of the left hand, the concavity of it regarding the abdomen and pubes ; it is then propelled gently onwards, through the urethra, till the beak has arrived beneath the symphysis of the pubes. *Second period.* The surgeon now changes the catheter from the horizontal position it previously had, and raises the handle from the abdomen to the vertical position ; then inclines it between the thighs of the patient until the straight portion of it is found to be parallel to the horizon, when a trifling check is experienced by the instrument engaging in the neck of the bladder, and enters it : it now depends on the kind of instrument used whether the urine makes its appearance or not.

If we consider the course a catheter takes to pass along the urethra, to arrive in the bladder, the handle describes a large segment of a circle and the beak a small one, the concavity of it looking towards that of the first. The extent of these curves is greater or less, according as the portion of the urethra that extends from the neck of the bladder beyond the symphysis pubis, is more or less curved ; hence it is not the same in every individual, nor at every period of life, being less in the child than in manhood, and not so great at this period of life as in more advanced age.

While the sound is being brought between

the thighs of the patient, it is necessary to impart to it a slight degree of pressure or impulsion, to make it enter the bladder, otherwise the beak, in place of passing under the symphysis pubis will strike against the sub-pubic ligament. This pressure should be very slight, if possible the weight of the instrument ought to be sufficient for this purpose, which can be regulated by not holding it too firmly.

In this case, where no unnatural impediment exists in the canal, much traction or elongation of the penis on the catheter is useless; indeed it is considered by some surgeons of much experience (*Roux,*) as injurious; for, by elongating the canal, it is necessarily contracted and flattened; it is also approximated to the pubic arch, and pressed strongly against it; all which circumstances impede considerably the passage of the instrument. But elongation of the penis is often requisite in old men, as it unfolds the soft and flaccid parietes of their urethra, and enables the instrument to pass with more facility; to answer similar purposes, full-sized instruments are also selected for this class of patients. There is another instance where elongation of the penis is absolutely necessary, viz. when the passage is narrowed by stricture; this manœuvre is oftentimes of use, as the beak of the instrument more readily enters the contracted orifice. This practice is much resorted to by the surgeons of La Charité, in Paris, when they attempt to

force through the contracted canal a conical sound.

To withdraw the instrument from the bladder, it is merely necessary to impart to it a gentle motion, the reverse of that which caused it to enter; delicacy of manipulation is frequently as much required in this step as in the introduction of it; for if the catheter is grasped by spasmodic contraction of the muscles, in the living subject, and the operator pays but little attention to it, but perseveres to remove the instrument, he will cause, not alone much pain and subsequent irritability of the canal, but often considerable hæmorrhage.

Operation of Catheterism by the manœuvre termed the "tour de maître." The patient is situated as in the foregoing operation ; the surgeon, in place of introducing the curved instrument, as has been just described, passes it into the urethra in the contrary direction, *i.e.* the convexity of it presenting to the abdomen, until the beak arrives under the symphysis pubis; he then gives the handle a half turn, and brings it opposite to the pubes, at the same time depressing it, and forcing the point inwards, which, if managed with the requisite skill, conducts the catheter into the bladder.

This method is scarcely ever resorted to at the present time, as it is a proceeding that adds to the difficulty of this operation, without making it more simple ; in fact, it may produce serious

mischief to the lining membrane of the urethra, as the beak of the staff may hitch in it during its revolution, and cause laceration of it.

The only case I apprehend, in which the "tour de maitre" plan is justifiable, is in patients whose abdomen is very prominent and pendent; when it may be inconvenient at the time of introducing the catheter, to place them in the horizontal posture: even in this case, it is unnecessary, as it is better to lay the patient on the floor, if neither couch or bed can be had, than to run the risk attendant upon this complex proceeding.

If catheterism is effected by means of a gum elastic catheter, the operator must be attentive that it is supple and well polished, he will also give the stilette the necessary curve, prior to passing it into the catheter. This instrument possesses one great advantage over every other that can be made use of, when retention of urine arises from disease of the third lobe of the prostate, and without inflicting any injury upon the canal, will enable the operator to overcome the impediment offered by it; if he is attentive when the catheter, armed with the stilette, has passed into the urethra to the depth of the prostate gland, to withdraw the stilette for an inch or so, which increases the curve of the catheter near the beak, and by this means allows it to avoid the third enlarged lobe, and to ascend into the bladder between the anterior vesical parietes, and the enlarged lobe.

CATHETERISM WITH STRAIGHT INSTRUMENTS.

Upon the practicability of this method, depends a considerable portion of the success of lithotrity.

Operation. The patient reclining in a horizontal posture, and the instrument being well oiled. *First period.* The surgeon having denuded the orifice of the urethra, raises the penis from the abdomen to an angle of about 45° , and slightly elongates it; he then passes the sound rapidly along the urethra as far as the bulb. *Second period.* The penis and instrument are then carried quickly downwards between the thighs, while the catheter is gently elevated towards its beak, and readily passes into the membranous part of the canal. *Third period.* The depression of the handle of the instrument and of the penis is still continued, while the former is at the same time to be propelled onwards, when the beak of it penetrates the prostatic part of the urethra, and so into the bladder.

I have repeatedly satisfied myself of the facility of this operation upon the dead subject, also my pupils; and have in a few instances performed it in the living.

Advantages of the straight sound: 1st, it renders the operation of catheterism less dangerous and much easier. It is almost impossible with a straight sound to make a false passage, without quitting the known direction of the canal, and thrusting it forward violently;

while it is easy to pierce the urethra, and make a false passage in the motion of depression or gliding, when the point of a curved instrument is under the symphysis pubis: 2nd, the operator may always know exactly the situation of the point of the instrument, from the direction of its body, or that part which has not yet entered the urethra: 3rd, the operator may always in cases of stricture, act with a straight sound as he would with a curved one; *i. e.* he may cause it to revolve on its axis between the fingers, while he keeps it applied to the obstructing point, in the known direction of the canal, and by putting it on the stretch with the other, &c. &c.*

Accidents attendant on Catheterism. The danger resulting from catheterism in the healthy state of the parts, is rupture of the urethra, if too much force is employed, and the beak of the catheter not maintained in the proper situation; this accident most commonly occurs at the bulbous part of the canal, and is caused by the operator allowing the point of the instrument to enter the dilatation of the urethra in this part of its course, instead of keeping it above the depression. After the false passage is made, if the propulsion is continued, the catheter is forced between the bladder and rectum, which is instantly recognised by the freedom of motion of the handle, and when depressed, the beak presses against the vesiculæ seminales and vasa deferentia, and produces much pain, which is referred by the patient to the glans penis.

Besides the actual rupture of the walls of the ure-

* Archives Gen. de Medicine, tom. iii. p. 398, 1823. Remarks on this method by M. Troussell.

thra, by the improper introduction of a catheter as just mentioned: occasionally these instruments, when allowed to remain in the canal, cause inflammation of one or both testicles; sometimes they excite irritation of the bladder, with an abundant mucous discharge: in some few instances, haematuria has been induced by the long sojourn of an instrument in the urethra and bladder; more frequently the bladder is perforated in one or more places, caused by the pressure of the end of the sound; this accident is more likely to occur in old than young persons, and particularly in those who suffer from spinal affections; finally, the sound is liable to be covered with calcareous incrustations.

CATHETERISM IN THE FEMALE.

This operation is seldom called for in the female, and is generally of easy execution, as the urethra is more straight, shorter, and wider, in this than the male subject; it may be required: 1st, in case of retention of urine, caused by paralysis of the bladder: 2nd, to ascertain the presence of calculi: 3rd, sometimes during parturition: 4th, in vesico-vaginal fistulæ: 5th, it is occasionally necessary in retention of urine, dependent upon retroverted or prolapsed states of the uterus: in all the preceding instances, but the two last, the operation is very simple, but in them some address is requisite.

Operation. First plan. The female is to be placed in the horizontal position, with the pelvis a little elevated, the thighs flexed and separated;

the surgeon stands on the right side of the woman, separates the nymphæ with the thumb and index finger of the left hand, to discover the orifice of the urethra, which is placed in a small triangular fossa, situated beneath the clitoris, above the vagina and between the nymphæ; then holding the catheter between the thumb and middle finger of the right hand, with the concavity looking to the pubes, he passes his hand under the thigh and guides the beak into the urethra, and glides it gently onwards, at the same time depressing his hand until it has entered the bladder.

Second plan. The catheter may be passed into the bladder with a much greater degree of delicacy than in the preceding operation, in the following manner: the patient being in the proper position, the operator passes the thumb of the left hand across the genital fissure, on a level with the clitoris; the right hand being armed with the instrument, he passes the point of it beneath the radial edge of the left thumb, which can then be made to penetrate the urethra with but little difficulty.

In many cases, it is merely necessary to pass the catheter in the continuation of the gracilis muscle, when it will almost find its own way into the bladder.

The orifice of the urethra is always a little nearer to the symphysis pubis in young people than in the old; in the latter it is also situated

at a greater depth, and is scarcely separated from the vaginal orifice ; the urethral orifice is always altered from its natural position in very advanced states of pregnancy.

If the passage of a catheter is required in cases of prolapsus and retroversio uteri, the operation is conducted in a different manner from what has been just described ; as in these affections the fundus of the bladder is drawn downwards and backwards, there is a corresponding change in the curve of the urethra, which, in place of regarding the pubes, the concavity is reversed and is directed towards the rectum, it is also increased ; from such a change of position, it is evident, that the convexity of the catheter should be directed to the pubes ; the operator will find it more advisable in such varieties, to use the gum elastic catheter than the silver one. A contrary effect is produced on the urethra during parturition, if the process is tedious so as to require the urine to be drawn off, the operator will find the urethra increased in length, and rendered more curved in the natural course, as the bladder is forced above the pubes by the fœtus and uterus, which in this way accounts for the elongation of the canal.*

* A very ingenious improvement in the female catheter has been lately made by Dr. Montgomery, Professor of Midwifery to the School of Physic in Ireland : instead of closing it with a plug, he has substituted a stop cock, and has also adapted to the bell of the

CHAPTER XI.

PARACENTESIS OF THE BLADDER, OF THE ABDOMEN, AND OF THE THORAX.

PARACENTESIS VESICÆ. The most frequent occasions which call for this operation, are permanent strictures, that may proceed to such a state of aggravation, as to completely close the urethra, leaving no space whatever for the passage of the urine; sometimes when inflammation attacks the strictured part, it cannot be subdued in sufficient time to allow the bladder

catheter a moveable silver cap, to which a fine bladder is attached; the instrument thus armed, is introduced into the female bladder, the cock is then turned and the urine flows from one bladder into the other; after being filled, it is removed from the catheter and emptied; the catheter remaining in situ, and as the cock is closed no urine flows, till the cap and bladder are again applied, which is then ready to receive it. This most comfortable contrivance prevents all exposure of the patient for the application of a urinal, no change of posture is necessary, nor admission of cold air to the patient, which is often very dangerous. It also prevents the necessity of frequent introduction of the instrument.—Edin. Med. Surg. Journal, vol. xxix. p. 325.

to be emptied through the urethra, in which case the operation will be also required, if the third lobe of the prostate is unusually enlarged, the necessity for paracentesis may be indicated: to those cases some surgeons conceive, that a narrow orifice of the urethra, congenital obstruction, abscesses and tumours pressing upon the urethra, paralysis of the bladder, ulcers of the urethra, which in healing close up the canal, call for the operation: these latter affections scarcely ever require such treatment for their relief.

The bladder may be relieved of its contents by one of four methods: *1st*, paracentesis above the pubes, or the supra-pubic operation: *2nd*, through the perinæum, or the perinæal method: *3rd*, by the recto-vesical plan, when the rectum is interested: *4th*, by opening the urethra posterior to the stricture, if it is that affection which calls for the operation, and which may be termed the urethral method.

Puncture above the Pubes. The operator being furnished with a scalpel, forceps, trochar, and canula, also a gum elastic catheter,—places the patient upon the edge of the table, with the legs hanging over it, the pubes being previously shaved; he then stretches the skin which he intends incising, and makes his incision for three inches in extent, parallel to the linea alba, from the symphysis pubis upwards; the superincumbent parts are then divided till the recti muscles

appear, these he penetrates between, and passes his finger into the wound to ascertain the position of the bladder, directing it behind the symphysis pubis, where he recognizes that viscus by its distended and elastic state. The operator next prepares to enter the bladder with the trochar and canula, which he conducts by means of the finger still placed on it, and plunges into its interior upon a line that passes from the symphysis pubis to that point where the third joins the fourth bone of the sacrum. The entrance of the trochar is instantly announced by the exit of urine, and the absence of resistance. The trochar is then withdrawn, and a gum elastic catheter passed through the canula into the bladder, when the latter is to be removed. During the period that the urine is flowing, attention must be paid that the catheter is in the bladder, as the sides of it collapse in proportion as the contents are evacuated: after the urine is drawn off, the catheter is to be retained *in situ* by proper bandages and tapes, while every care should be taken that no urine infiltrates between the bladder and the surrounding cellular tissue, as it will induce inflammation wherever extravasated, and lead to much distress.

Puncture of the Bladder through the Perineum. In order to perform this operation, the surgeon is to be provided with the same instruments as in the last operation, but the trochar must be considerably longer, from seven to eight

inches ; the patient being situated and secured as in the lateral operation for lithotomy, the surgeon makes an incision about an inch and a half long through the integuments, about midway between the tuber ischii and verge of the anus, and continues the dissection through the deeper-seated parts, till he has passed between the accelerator urinæ and erector penis muscles ; he then introduces the left index finger into the rectum, to separate it from the trochar, the handle of which he rests in the palm of the right hand, and passes the forefinger along the trochar for some distance, to have more command over it ; he then forces it through the remaining structures, till the flow of urine indicates that the bladder has been pierced. To effect this step, with every attention to the patient's safety, the instrument should follow a line that extends from the tuber ischii to the umbilicus, which will conduct it to the side of the neck of the bladder, and of the inferior fundus. The plunge of the trochar is decidedly the most important part of this operation, and demands for its execution the perfect knowledge of the anatomy of the perineum : if the handle is too much depressed, the point of the trochar will pass between the anterior surface of the bladder and the symphysis pubis ; if too much elevated, the point may pass through the posterior surface of the bladder, and wound the vasa deferentia and vesiculæ seminales, or even the ureters ; or it may not even enter the bladder, but run between it and the rectum,

and thence into the abdomen; if the handle of the trochar is kept too near the tuber ischii, the point will perforate the prostate; finally, if the handle of the trochar is approached too near the median line of the perinæum, the operator will send it between the lateral surface of the bladder and the side of the pelvis, and not attain the object in view.

Puncture of the Bladder through the Rectum, or the recto-vesical plan. The surgeon, if he selects this operation, should be provided with a canula and trochar of the same length as in the perinæal operation; it must be also curved. The patient being situated as in the last operation the two first fingers of the left hand, well oiled, are to be passed into the rectum, as deep as they can go, to examine for the inferior fundus of the bladder, posterior to the prostate gland; the point of the trochar being sheathed in the canula, it is conveyed on the fingers already in the rectum; when the canula has passed to the necessary distance, the trochar is protruded from it, and perforates the bladder, after which the urine immediately begins to flow. Through the canula a gum elastic catheter is conveyed into the bladder, and the former withdrawn.

The operator should be most attentive to the direction he gives the trochar when performing the recto-vesical perforation, or irreparable mischief may be the consequence. If the instrument is carried too far back, the peritoneum must be perforated; if, to prevent this accident, the point

is not fully entered to the necessary distance into the rectum, the bladder will be pierced immediately behind or through the mesial line of the prostate, and the vesiculæ seminales and vasa deferentia wounded; the lesion of these parts is said to be instantly indicated by the patient complaining of much pain at the glans; they may ultimately be obliterated by the inflammation ensuing to this lesion, and the testicles consequently rendered useless.

Puncture of the Bladder through the Urethra. The patient being situated as for lithotomy through the perinæum, the operator marks well the course of the raphè, and makes an incision through it, commencing about an inch posterior to the scrotum, and continues to cut upwards into the perinæum towards the urethra, the edges of the wound being carefully separated by the assistants; the portion of the urethra posterior to the stricture being exposed, it is to be opened, when the urine immediately makes its appearance. It is then necessary to introduce a catheter through the wound in the urethra, into the bladder; or the incisions may unite and cause a second operation.*

Observations. In the different operations for paracentesis, I have inculcated the necessity of dividing the skin with the scalpel, preparatory to the trochar being used, as tending to enable the operator to perform the

* Cooper's Lectures, by Tyrrell, vol. ii.

operation in the most secure manner: some writers, particularly the French, advise piercing the bladder at one plunge of the trochar, without any previous division of the integuments; this practice is attended with no advantage, and may be productive of much mischief, as the force necessary to penetrate the skin with a triangular-pointed instrument is very considerable; after the resistance is overcome, the plunge cannot be regulated so instantaneously as to prevent the trochar passing further than is intended, which may actually be driven through the sides of the bladder to the injury of other organs: this remark holds good of paracentesis abdominis and thoracis.

Many surgeons are opposed to paracentesis of the bladder above the pubes, apprehensive that the urine will be extravasated into the surrounding parts, and produce gangrene and sloughing; the bladder may be so thickened and otherwise diseased as not to ascend as high as the symphysis pubis, which will add considerably to the embarrassments of the operation, perhaps cause a total failure; they also urge against it the danger of wounding the peritoneum.

These are doubtless strong arguments against the performance of the operation in this situation; yet they can be answered—the risk of any injury being committed on the peritoneum, can be avoided by only moderate care; it is the duty of the surgeon, before commencing the operation, to inform himself if the bladder is so distended as to ascend above the pubes; let it be also borne in mind, the more it ascends above these bones, the better will the serous membrane of the abdomen be protected; it is, of all the operations for tapping the bladder, the

one most easily achieved ; the only valid objection which appears to me that can be brought against it, is the probability of the bladder receding from the end of the catheter after the contents have been expelled, and in this way giving rise to the extravasation of urine. This plan possesses a redeeming advantage over all the others, namely, if the urethra is so much disorganized that it can never again perform its functions, and that the patient must submit to an artificial outlet for the urine, this is the most convenient situation for it.*

Tapping through the perineum is the most difficult operation, and requires considerable anatomical knowledge and skill ; still these disadvantages should not deter the surgeon from its execution, provided the nature of the case calls for it. A competent anatomical information and attention to the preceding directions, will always enable the operator to steer clear of the dangers, and to open the bladder. It possesses one advantage over the operation above the pubes, viz. that it is performed in the most depending part of the bladder, where the urine first begins to collect, also in the greatest quantity ; the bladder is also most fixed in this part of its extent, being rendered so by the anterior ligaments, there is consequently less danger of this viscus receding from the catheter, after the expulsion of the urine.

The operation by opening into the urethra is easily

* The gum elastic catheter can be supported in this situation for an indefinite period, without any inconvenience to the patient :— Boyer gives two cases of it ; in one it was allowed to remain for three months, in another for five months.—*Traité des Mal. Chirurg.* tom. ix. p. 155.

executed, provided the surgeon will pay attention to the exact course of the canal, and the instant it is perforated to pass a catheter through it, into the bladder; if any delay occurs in detecting the position of the canal, the introduction of a sound into it, as far as it is pervious, will oftentimes afford much assistance to the operator.

The recto-vesical puncture, is seldom performed at the present time; it was first introduced into practice by Fleurant, and then by Dr. Hamilton of Edinburgh.*

In both these cases the bladder was enormously distended, rising into the abdomen as high as the umbilicus, and descending as low into the pelvis as that cavity would permit: in the case related by Dr. Hamilton, the bladder protruded nearly to the verge of the anus; in such cases, this operation can always be resorted to, without any danger of wounding either the prostate, the vesiculæ seminales, the vasa deferentia, or the peritoneum. But in default of such distention, it is an operation that has few advocates at the present day.

Some practitioners, impressed with the idea that the canula cannot be endured by the rectum, withdraw it, and if necessary puncture a second time; such practice multiplies the number of punctures, and is by no means called for. In the cases recited by Hamilton and Home, the bladder emptied itself through the first puncture, after the gum elastic catheter had accidentally slipped from the bladder and rectum. This operation is contraindicated when the prostate gland is very much enlarged, or if haemorrhoidal or other tumours are present. Frank † relates a case, in which the surgeons were de-

* Philosophical Transactions, 1776.

† De Cur. Hom. lib. v. p. 11.

tered from puncturing the bladder above the pubes, in consequence of the extreme obesity of the patient, the attempt was made through the rectum, but failed: after death, the fat under the abdominal integuments was four and a half inches thick, a large tumour occupied the neck of the bladder, and many calculi were found in it; the ureter was wounded.

I would advise the student, when practising these operations, after he has plunged the trochar into the bladder, to let it remain in it, and proceed to dissect the parts, in order that he may examine their relations; which will be the best means he can adopt for that purpose.

Paracentesis vesicæ in the Female. This operation may be performed above the pubes in the same manner as directed in the male subject; or through the vagina by means of a trochar passed through the vaginal-vesical partitions.

It is an extremely rare operation, in this sex.

Paracentesis abdominis. This operation is required to give exit to the fluid contents of the peritoneal cavity, as in ascites; it is also occasionally resorted to, to relieve ovarian dropsy.

The abdomen may be punctured on either side; by some the right is preferred, as the hollow viscera are chiefly directed to the opposite side; also the omentum descends lower on this side than the right: however, when examining the abdomen, if either of the hypochondria present an indurated and enlarged swelling, the opposite region must be selected: practitioners differ considerably as to the point of election to puncture the

abdomen; some prefer the mid point between the umbilicus and the crest of the ilium; some, as Monro and Boyer, between the navel and the ant. sup. spin. process of the ilium: Sabatier recommends the point between the false ribs and the crest of the ilium, the spines of the lumbar vertebræ and umbilicus: others advise the centre of a triangle, formed by the umbilicus, the iliac crest, and the edge of the false ribs.

In general I have seen paracentesis of this cavity performed about midway between the umbilicus and the symphysis pubis, with no sinister result.

Operation. The student being provided with a scalpel, a trochar, and canula, selects the point about midway between the umbilicus and symphysis pubis, and makes the integuments tense with the left hand, he incises through them for about one inch, then holding the trochar in the right, he places the index finger on the canula, about one inch distant from the point, to direct it, also to limit the depth of the puncture; he next forces it through the remaining structures of the abdominal parietes, till the absence of resistance announces to him, that he has entered the cavity, when he immediately withdraws the trochar, at the same time simultaneously gliding the canula inwards to the abdomen.

Objections have been brought against tapping the abdomen in this situation; such as the danger of perforating the urinary bladder, which may be so distended as to ascend up to this point; or of

wounding the urachus, which is sometimes previous, and communicates with the bladder, and will consequently induce extravasation of urine if it is opened.

To guard against these accidents, the operation has been performed midway between the umbilicus and the ant. sup. spin. process of the ilium ; this place is not free from objections either, as the epigastric artery will incur some risk of being opened.

In the living subject, during the flow of the fluid, the canula is liable to be blocked up by some of the loose contents of the abdomen falling against it, or by flocculi of false membranes, the result of the previous inflammation ; these can be removed by passing another and a longer canula through the first. The operator, during the discharge of the fluid, will be careful to prevent syncope, by swathing the abdomen with a broad flannel roller, passed around it above the trochar puncture, which, by the pressure, compensates in some manner for the support which had been afforded to the diaphragm by the aqueous contents of the cavity, and allows it to regain its function in respiration in a gradual and regular way.

Paracentesis thoracis. To give exit to matter contained in either of the pleuritic cavities, whether arising from affections of the organs situated within them, as in empyema, and seropurulent effusions,* or when the matter of a

* Transactions of the King and Queen's College of Physicians,

common abscess by some unforeseen cause bursts into their interior, in place of being discharged externally; for the purpose of discharging sanguineous collections, as in hæmatothorax; to relieve the lungs from the pressure of serum, as in hydro-thorax, also from the pressure of air in emphysema and in pneumo-thorax; and in the more complicated state of air and pus being collected in the thoracic cavity,—is the operation of paracentesis thoracis, occasionally performed by the surgeon.

M. Laennec presses the necessity of this operation in certain cases of acute pleurisy, as when the effusion has been very copious from the beginning of the affection, and increases so rapidly as to give rise after a few days to a general or local anasarca, and to threaten suffocation.*

The place of election is generally between the fifth and sixth ribs, about midway between the anterior and lateral parts of the chest, or a little anterior to the indigitation of the serratus anticus magnus muscle.

Many reasons point out this spot as being best suited for the operation, “as the upper lobe

vol. ii. p. 1, for a successful cure of paracentesis thoracis, when eleven pints of fluid were drawn off, by Dr. Archer. Also Lancet, vol. ii. p. 928, 1829-30: this case, judging from the history of it, was conjoined with pneumo-thorax.

* Laennec, second edition, translated by Dr. Forbes, p. 475, et seq.

more frequently adheres to the ribs than any other part of the lungs, and that the lower lobe is frequently attached to the diaphragm." (*Laennec.*) On the right side the liver often ascends as high as the sixth, even the fifth rib; while on the left the stomach may be unusually distended, so as to force the diaphragm into the chest, nearly to a similar height on this side; a greater probability of this occurrence is derived from an enlarged spleen.

Prior to undertaking the operation, it is expedient for the surgeon to inform himself, if there are any old adhesions of the lungs to the interior of the chest, corresponding to the place where he intends incising, which the respiratory murmur is certain to indicate; but if on repeated examination, the sound on percussion is dead over this point, (or indeed over any other,) and that the sound of respiration is wanting, we may safely make an incision, and with less slowness and caution than are commonly used.*

Operation. The patient being situated in the most convenient position for the discharge of the fluid, at the same time attending to his comfort; at the place already indicated, the surgeon makes an incision a little above the rib, through the integuments, to the intercostal muscles; he then depresses the inferior edge of the

* Laennec, translated by Dr. Forbes, p. 578.

wound to the superior edge of the rib, and cuts carefully through the attachment of the intercostal muscles to it; having laid bare the pleura costalis, he pierces it cautiously with a trochar and canula, and draws off the collection of fluid within in the chest.

By attending to this manner of operating the intercostal artery, and its large branches are protected; while the wound in the integuments, after the canula is withdrawn, forms a complete valve over the intercostal opening, and completely closes it.*

One of the chief obstacles to the success of paracentesis, in some instances, is the difficulty of procuring the expansion of the compressed lung; which M. Laennec proposed attempting to remedy, by the employment of the piston cupping glass: but Dr. Forbes, his translator, advocates the use of exhausting syringes, as formerly recommended by Scultetus and Anel:—"a proposition that seems to hold out many advantages in certain cases."—p. 479, *Translation*.

* *Vide Lancet*, vol. ii. p. 456, 1829-30, for an ingenious contrivance by Dr. Carson, of Liverpool, to draw off fluid collections from the thoracic cavities, at the same time preventing the ingress of the external air through the wound—his tube acts on the principle of the siphon: I apprehend it will only answer in cases where the fluid is thin; if any flocculi of false membranes come across the small foramina in that part of the instrument that is passed into the thorax, it is useless, and must be removed, *in toto*, in order that it may be cleaned and again introduced. I imagine that a canula fitted with a stop-cock and bladder, similar to Dr. Montgomery's female cathe-

With all due submission to so great an authority as M. Laennec, and to so highly a respectable one as Dr. Forbes, to whom the profession is so much indebted, for bringing into general use, by his able translation with notes, the editions of Laennec, I apprehend that the application of the syringe will be only an unnecessary annoyance to the patient at the periods of the disease that the operation is at present performed, and without any commensurate advantage being derived from it. However, I feel satisfied that the object intended by both these gentlemen will be best attained by the more general adoption of auscultation, which will enable practitioners to recognize effusions at their origin, and actual locality, thereby having it in their power to operate early, and consequently, with greater chance of success.*

Puncture of the Pericardium. This operation has been advocated by Senac in cases of hydrops pericardii ; and in one instance it was per-

ter, (see note at page 431,) would answer tolerably well for the purpose of drawing off the fluid, without allowing any air to penetrate into the thorax. The instrument being prepared, when the point is passed into the thorax, the cock should be turned to allow the fluid to pass into the bladder ; after it is full, it is to be removed from the canula, the cock being previously closed, which will form a complete barrier to the passage of any fluid through it, till the bladder is again applied, in a perfectly flaccid state ; the instant the cock is opened the fluid will again flow from the thorax into the bladder ; and in this way the operation repeated till all the fluid is evacuated.

* Laennec, p. 480.

formed by Desault, who incised the soft parts between the sixth and seventh ribs of the left side, opposite to the apex of the heart; through the wound he introduced the index finger, and perceived a sac full of fluid, which he conceived to be the pericardium, and opened it with a bistoury, conducted on the finger, and gave issue to five or six ounces of fluid: the patient died on the following day, when it was discovered that the pericardium had not been opened, and that the fluid was discharged from a sac situated at the anterior edge of the lung.

To obviate such a mistake, M. Skieldemp proposes to open the pericardium by trepanning the sternum, the crown of which is to be applied after the integuments have been cut through, a little below the place where the cartilage of the fifth rib unites to the sternum, by which a triangular space is denuded, situated between the two laminae of the pleura, a little nearer to the left than to the right side. By operating in this way, the pericardium can be opened without any dread of injuring either of the pleura, as it is exposed in the anterior mediastinum. A large crowned trepan is necessary for this operation, to allow the finger of the operator to pass with facility through it, to ascertain the exact position of the serous membrane of the heart, which he penetrates with a bistoury or trochar.*

* *Vide* Boyer, *Traité des Malad. Chirurg.* tom. vii. p. 399.

CHAPTER XII.

HERNIA.

HERNIA, which is of so much interest to the practical surgeon, as to its operative details, cannot be rendered so to the student, in the dead subject, as the affection does not exist in the normal or regular state of the parts; hence I apprehend, that the different steps of this operation will not be as demonstrably instructive as I could wish for his advantage; still, by combining the operative part with the anatomy, the principle of it will be well understood.

The student ought to bear in mind, that as this operation is intended for the relief of protruded portions of the abdominal contents, of which but a small part may be contained in the herniary tumour—or nearly the whole of the viscera may be lodged in it, the coverings of which may be either very thick or thin, he must conduct his operation so as not to injure any of the contained parts—he should also recollect the necessity of protecting the blood vessels, which, in most instances, run in the vicinity of the con-

stricted parts, or neck of the sac, and are always endangered when about to relieve this impediment to the return of the viscera.

Hernia has been named from its situation in the abdominal parietes, as umbilical, inguinal, scrotal, femoral, ischiatic, perinæal, vaginal, thyroid, terms indicating the different foramina through which it may protrude; if it passes through any other portion of the abdominal walls but the diaphragm, it is termed ventral, which generally forms in the linea alba, or its vicinity. It has been also denominated from its contents; as enterocele, when intestine is alone contained in the sac; epiplocele, when only the omentum occupies it; and entero-epiplocele, when both intestine and omentum are found in the tumour. A compound term is sometimes employed, expressing both the situation and contents of the rupture, as entero-bubonocele, epiplom-phalocele.

Surgeons have also divided herniary tumours into reducible and irreducible; in the first, the viscera descend and return freely into the abdomen; in the second, they are prevented from being returned into that cavity, either in consequence of having increased much in volume, or from having formed adhesions to each other, or to the hernial sac: they are also irreducible, though none of the foregoing causes exist, when the opening through which they have passed is too small to allow of their being reduced, thus constituting the strangulated or incarcerated state,

for which the operation is more particularly required.

Umbilical Hernia. It may be either congenital or accidental; when congenital not unfrequently the whole of the intestinal canal, the liver, spleen, the epiploon, and sometimes the stomach, are found in it: while the accidental may occur either in infants or in adults; in the former it generally supervenes when the cord has fallen off, or may take place during the first periods of life; and often depends upon a weak and enlarged umbilical foramen; or from a want of contraction which it naturally possesses; from weakness in the cicatrix, or from the non-adhesion of the umbilical vessels to the edges of the foramen and the skin: it has a constant tendency to increase and protrude.

When this affection is congenital it always passes through the umbilical foramen, and is soon brought under the cognizance of the surgeon, who will adopt the palliative treatment recommended by Scarpa, in preference to the operation of Desault, as advocated by Bichat.

When this species of hernia occurs in the adult, it seldom passes through the umbilicus, but to one side of it, or through the linea alba in the vicinity of that foramen, and usually contains portions of the omentum, the commencement of the small intestines, and occasionally the stomach. The female is more liable to umbilical hernia than the male; those chiefly suffer from

it, who have borne many children; it often makes its appearance during pregnancy, and if not strangulated, it will be relieved after the period of utero-gestation is passed, when it can in most instances be retained by means of a padded belt. It generally forms in a slow manner, and is almost always larger near the umbilicus than the part that corresponds to the fundus of other hernia: in very fat persons this species of hernia may not protrude beyond the integuments, but will conceal itself among the adipose membrane and the different layers of the muscles; it is then with difficulty recognised, being of a broad and flat appearance; this may also occur in very thin persons, but in general the hernia in such individuals is of a pyriform shape. (*Cooper on Hernia.*)

Umbilical hernia, when abandoned to itself, may acquire an enormous magnitude, and contain a considerable volume of the viscera, which adhere to each other, cause the absorption of the superincumbent parts, and ultimately become adherent to the skin itself. It was such a train of phenomena that led the older surgeons to conceive that this hernia was deprived of a peritoneal covering; however, the researches of Cooper and Scarpa have most satisfactorily proved, that umbilical hernia in the commencement of its formation, possesses a sac similar to the other kinds of hernia; which ultimately is partly absorbed and partly ruptured by the pressure of the con-

tents of it; and in this way induced the idea that a sac never existed.

Operation. The patient reclining upon a table, or leaning back in an arm chair, if the hernia is small, an incision is to be made for the length of the tumour, and from above downwards, also with the greatest precaution, as the integuments may be, not alone very thin, but also may adhere to the contents; the superincumbent parts being next divided seriatim upon a director, the sac, if it exists, is to be opened, and the finger being introduced through the stricture, it is to be enlarged *from below upwards*, for from half to one inch; when the protruded parts are to be returned into the abdomen. This operation is easily performed; but exposes the patient to peritoneal inflammation, in consequence of a direct opening being left through the integuments into the abdomen.

If the hernia is not very large, Sir A. Cooper advises to operate as follows: let an incision be made from the centre of the tumour perpendicular downwards through the integuments, next a horizontal one to meet the first at right angles and form a T, the flaps being dissected and thrown downwards, will expose a considerable portion of the hernial sac.

After it is opened, the finger is to be passed below the intestine to the orifice of the umbilicus, and the opening is to be enlarged from *above downwards* to the requisite degree. When

the protruded parts are returned, the flaps of the integuments fall over the opening of the umbilicus, and cover it; lessening the risk of peritoneal inflammation by more readily closing the wound.

If the hernia is very large, to avoid exciting peritoneal inflammation, which is liable to ensue if the sac is opened, it is conceived most prudent to free the stricture, without cutting into the sac; in two cases of this kind Sir A. Cooper operated successfully, by making a small incision through the integuments over the seat of the stricture; he then dissected cautiously down to it, and passed his finger between the sac and the stricture, dilated it, and returned the viscera.

Inguinal Hernia. This variety of the disease is due to the protrusion of the viscera, through the inguinal rings and canal, and is of two kinds: 1st, it may pass out through the internal ring, descend along the inguinal canal, and penetrate the abdominal ring, and so pass into the scrotum: or 2nd, it may take a more direct route to pass into this appendage, and occupy but a small portion of the inguinal region, e. g. by starting from the abdomen directly through the abdominal ring: the first of this variety is named oblique inguinal hernia, and the second the direct hernia, the former has been also designated by Hesselbach and Scarpa, external inguinal hernia, and the latter internal inguinal hernia.

Of all kinds of hernia, inguinal is undoubtedly the most frequent; Monnikhoff, a herniary surgeon of Amsterdam, witnessed 2,184 ruptures of this species; it is also more frequent in the male than in the female; in 4060 cases of inguinal hernia, presented to the London Truss Society, of this number all but 34 were in the male; the right side is by far more liable to it than the left, in the proportion of 51 to 34, which is attributed partly to the pressure exercised by the liver upon the intestines on that side, to the inclination of the mesentery from left to right, to the habit of lying upon the right side; but principally to violent exertions, during which the abdominal cavity is much contracted, by the action of all its muscular parieties, and the position the individual places himself in, as preparatory to their being carried into execution, powerfully predispose to its formation.*

When inguinal hernia occurs prior to, or immediately after birth in the male, the viscera descend into the tunica vaginalis scroti, and are in immediate contact with the testicle; as the communication between these two cavities has not yet been closed up, the viscera are consequently without a proper hernial sac, constituting what is termed "hernia congenita;" but if the protrusion does not take place till after this passage is obliterated, the hernia is then covered

* Cloquet, Researches Pathologiques sur les Causes de l'Hernia, p. 4.

with its true sac, derived from the peritoneum. Almost all the abdominal viscera may pass into inguinal hernia, and are classed in the following order, in point of frequency; the ilium, jejunum, omentum, colon, cœcum, urinary bladder, the ovaries, stomach, uterus, duodenum, and the spleen. The small intestines more frequently pass through the right inguinal rings and canal, while the omentum is oftener found in the opposite side ; occasionally, the viscera of one side of the abdomen penetrate through the rings of the other side ; thus the cœcum and right colon have been met with in the left inguinal canal, and the left colon in the right.

Oblique inguinal Hernia. When oblique or external inguinal hernia forms, it may pass either gradually or start suddenly through the internal ring, carrying before it the peritoneal membrane, to form the sac ; it then glides under the inferior edge of the transversalis abdominis muscle, and insinuates itself beneath the internal oblique, to follow the course of the cord, where it is covered by the cremaster muscle ; the hernia ultimately escapes through the abdominal ring, and descends into the scrotum : *form*, it presents a tumour of a pyramidal shape, occupying the groin, extending from below obliquely, upwards and outwards. In recent cases, the hernia descends in the cellular membrane, which unites the spermatic cord to the cremaster m., the cord being situated posterior to the protruded intestines—the same relations are

observed between the hernia and round ligament of the uterus in the female, as between it and the cord in the male.

But if the hernia is voluminous, and of long standing, by the effects of constant pressure, the component parts of the cord are unravelled, which are held together, but by very lax cellular membrane, and remarkable changes take place in the relative disposition of these parts, *viz.* the cord and hernia; as the spermatic vessels may run upon the anterior part of the tumour, and the vas deferens behind it, or *v. v.*; and will incur great danger of being wounded if the cremaster muscle is opened in a careless manner.

The relations of this species of hernia to the epigastric artery, both in recent and old cases, are of considerable importance, and require to be clearly understood, to guard against serious accidents, when the operation is being performed. As the hernia penetrates through the internal ring, the inner side of which may be considered as being bounded by the artery, it consequently is placed to the internal side of the neck of the sac, while the hernia lies anterior and before it. In proportion as the hernia increases in size, the obliquity of the inguinal canal is obliterated, and the two rings are so altered in their relations, that they become almost directly anterior and posterior to each other; the length of the inguinal canal is also considerably diminished; these deviations from the normal state of the parts

admit the viscera to pass directly from behind forwards, while the artery is still placed internal to the neck of the sac, but the body of the tumour lies ulmost external to it: this fact was first satisfactorily proved by Scarpa.

Direct inguinal Hernia. When the hernia is direct or internal, the anatomical relations of the neck of the sac, and the sac itself, differ in a remarkable degree from the former variety;—the epigastric artery holds the same relation to the neck of the sac, as it does in the natural condition of the parts, to the abdominal ring, through which the direct hernia alone passes; the vessel is consequently external to it, while the spermatic cord may be also considered invariably as situated external and inferior to it. To these almost unvarying relations there are three remarkable exceptions upon record:—the late Mr. Todd, in two cases of old direct hernia, observed the spermatic cord to pass over the neck of the sac, and descend to the testicle, *on its internal side,** while M. Hesselbach states, that in one instance, he met with the epigastric artery ascending to its destination *internal* to the neck of the sac of a direct or internal inguinal hernia.

Congenital inguinal Hernia. This variety does not differ from that of the oblique hernia, except that it has no proper sac, being contained in the prolongation of the peritoneum, that forms the

* Dublin Hospital Reports, vol. ii.

tunica vaginalis ; it is generally formed prior to birth, but may take place some time after it, and is observed to occur occasionally in the adult.

This hernia in children contains nothing but intestine, the omentum being too short at that period of life to descend into it; if it is allowed to increase it soon augments in volume, and will not alone press upon the testicle, but after the lapse of some time, force it backwards and upwards towards the ring.

Double inguinal hernia, according to Scarpa, consist of the congenital species, with the ordinary kind, both penetrate through the inguinal ring.

Coverings of oblique inguinal Hernia. It is necessary for the surgeon to take into account the following lamina, which he is to divide, in order that the contents of a rupture of this species may be exposed, some of which may be considerably changed from the healthy state : 1st, the skin and superficial fascia ; this membrane may be either very much condensed and thickened, or it may be thin and weak ; it contains always a greater or less quantity of fat : 2nd, the cremaster muscle ; in some instances it is thin and unravelled, allowing the subjacent parts to be seen, or it may be much increased in thickness, and present a tawny colour (*Scarpa*) : 3rd, subjacent to this muscle is a quantity of cellular membrane, often much condensed, so as to appear more of the character of fascia : 4th, the sac of the hernia,

derived from the peritoneum; which is flocculent on its external surface. If the coverings of oblique inguinal hernia, which has not descended through the abdominal ring, be contrasted with those of the same variety of rupture which has completely escaped from the canal, some difference will be observed, viz. the former has, lying anterior to it, the tendon of the external abdominal muscle, and the fleshy fibres of the internal oblique.

Such are the most remarkable of the different tissues which the surgeon calculates upon meeting in this variety of hernia; but the anatomist, who arranges them in a contrary direction to the surgeon, *i. e.* from within outwards, describes them as consisting of a few others, which the reader will find detailed in the anatomy of inguinal hernia.

Situation of the Stricture in oblique Hernia.
The situation of this impediment to the return of the rupture, can never be referred to any particular place, but varies according to circumstances, whether the disease is of old or recent standing: 1st, it may be found in the abdominal ring: 2nd, more frequently in the internal ring conjointly with the neck of the sac: 3rd, it may be formed by the inferior edge of the transversalis abd. muscle: 4th, it may be situated in the interior of the sac, and may depend either upon the presence of bands of lymph, the result of inflammation, or the intestine may be forced through a portion of omentum, when both

these parts conjointly form the contents of the hernial sac.

Operation. The instruments necessary for a hernial operation, are a few sharp edged scalpels, a director, with the stricture knife; that of Sir A. Cooper's being the one in common use in these countries, a few ligatures and needles.

Since I have commenced lecturing upon operative surgery, a hernia knife diametrically the reverse in shape of Sir A. Cooper's, is exhibited to my class, and possesses the advantage of dividing the stricture, with much less of the motion of sawing than his; it being simply necessary to turn the edge of the knife to the stricture, when the parts instantly give way; if an artery should happen to be in the line of the incisions, it eludes the edge of the knife, and turns away into the surrounding cellular membrane. This shaped knife was first used by M. Dupuytren: from my experience of it in the living subject, I can say but little, but feel great pleasure in being able to adduce the testimony of others as to its utility; it has been used for some years at Mercer's Hospital; and has received the approbation of the surgeons of that establishment.

All that the author can now do, is to recapitulate the line of the incisions, and the different steps of the operation as they are effected, when the disease is actually present: we must consequently suppose a hernia to exist. The hair of

the groin being previously removed, and the subject placed upon a table of suitable height, with the legs hanging over the edge of it. *First period of the operation.* The cutaneous incision is to extend from about one inch above the abdominal ring, to nearly the bottom of the tumour, and in the very centre of it; which is the best guarantee to protect the vas deferens if it runs upon the anterior part of the sac; this line of incision will also guard the operator from committing any error in case the hernia should be only partially enclosed in a sac of serous membrane; as is sometimes the case, when the caput coli, or sigmoid flexure of the colon constitutes the hernia; (Scarpa;) in this incision, the external epigastric artery is always cut across, and is of no importance. *Second period.* The superficial fascia being now exposed, it is to be laid open both upwards and downwards, of equal extent as the skin, which is effected by pinching a small portion upwards with a forceps, and cutting it horizontally close to the point of the forceps, by which a small circular foramen is made in it; through this opening the director is to be passed, which protects the subjacent parts, while upon it the operator divides the membrane. *Third step.* Is occupied in cutting through the cremaster muscle, which demands considerable care and forethought, to protect the component parts of the cord as the vas deferens or arteries; if they should by any chance be unravelled and separated from each other, one or both may be

thrown upon the anterior part of the sac, and thus incur great danger from the knife; from which they are completely protected in their ordinary relations to it. *Fourth period.* The sac is now exposed, and the cellular membrane being cleared away, it is to be opened with every precaution, so as not to injure the contained parts; which is best effected by incising it in the same manner as recommended for the cremaster muscle, and towards the inferior third of the sac, as this part of it is separated from the intestine by whatever serum is contained within the sac; the incision is then prolonged upwards, and the protruded viscera fairly exposed. *Fifth period.* Division of the stricture. If the hernia is not incarcerated by the external ring, and if no adhesions exist in the body of the sac, the right index finger is to be passed carefully upwards towards the internal ring, where the stricture will be found, formed in part by this foramen, partly by the neck of the sac, and often by the inferior edge of the transversalis abdominis muscle; or it may be produced by any two of the preceding, or by one of them. The exact position of the stricture being ascertained, the operator places the hernia knife, recommended in this work, with the flat surface on the pulp of the index finger, and the edge slightly sunk into it, and then conveys the finger thus armed upwards through the sac, till it is engaged under the stricture, when he presses the knife and

finger close to and firmly against the constricting part, and turns the edge of the knife against it, when if it is merely membranous the stricture yields; if not, it will be necessary then to use the knife, as the cutting instrument, with which the surgeon cuts *obliquely upwards and outwards*, to a sufficient extent to obtain freedom for the return of the protruded viscera; by incising in this direction the internal epigastric artery will be always protected.

Sixth period. The intestine is then, if healthy, to be returned, by passing the portion nearest to the abdomen into it with the index finger, and retaining it *in situ*, till a second portion has been returned, and by a succession of attempts of this nature, if no adhesions or other impediments exist, the whole mass can, with a little patience and skill, be passed into the abdominal cavity; if both intestine and omentum are present in the sac, the omentum is to be unfolded and spread out, to obtain a full view of the intestine, which in these instances seldom exceeds a small knuckle, which is to be reduced before the omentum.

In those cases when omentum alone occupies the sac, if unaltered in texture, it is to be returned; but should a large quantity of it have descended, and is much altered in structure, it is confessed by surgeons, that the best practice consists in unfolding it, securing the vessels that bleed with very fine ligatures, and having cut

away the diseased part, the sound portion is to be returned. Often omental hernia produces the most radical cure after the operation, as it remains in the vicinity of the ring, becomes united to it by adhesive inflammation, and thus forms an insuperable barrier to the reproduction of the affection.

Is the surgeon liable to be deceived when returning the protruded viscera, or can they be passed into any other cavity but that of the abdomen? In one instance of scrotal hernia, the operation was performed to relieve the affection and reduce the protuded parts; the patient did not receive the relief that was expected to follow the operation, though the stricture was relieved and the parts apparently reduced, the bowels remained constipated, and he suffered considerable distress: in the course of twenty-four hours he died. The autopsy exhibited that the parts were strangulated both at the external and internal rings, between which the sac had expanded itself into a large cyst, which extended into the basin of the pelvis on the one side, and into the hollow of the ileum on the other, lying between the muscles: into this space the intestine and omentum were returned, after the stricture was supposed to have been freed;—from the distance that intervened between the two rings, it was impossible in this case for the operator to reach the internal one with his finger, from which he conceives, that had he been previously

aware of this perplexing and extraordinary circumstance, to afford the patient the necessary relief, it would have been requisite for him either to cut down upon the internal ring, or to have continued the incision from the one to the other.*

Internal or direct inguinal Hernia. This rupture is caused, as has been before mentioned, by the viscera being forced directly forwards through the abdominal ring, consequently having what is termed the internal ring to its external side.

The coverings of internal hernia are not always regular, viz. if it starts through any of the slits or fissures that are in the transversalis fascia, and conjoined tendons of the transversalis and internal oblique muscles; the sac will be then covered, but by the common integuments and superficial fascia (*Cloquet*);—if these slits are too small to allow of a passage through them, the transversalis fascia, and conjoined tendons of the transversalis and internal oblique muscles, will be then forced before it, and constitute an additional covering for it (*Lawrence, Cooper, Langenbeck*). I conceive it may be also covered by that part of the cremaster muscle which arises posterior to the internal pillar of the abdominal

* Dublin Hospital Reports, vol. iii. p. 383.

A similar variety was encountered by M. Velpeau. The cause being suspected, the second stricture was freed, and the patient recovered. Anat. Chir, vol. ii, 90.

ring and by the intercolumnar fascia. The relations of the direct hernia to the spermatic cord and epigastric artery, have been already indicated, see page 458.

Operation. It is to be conducted in a similar manner as the last, when the situation of the stricture is ascertained, it should be divided *upwards with a slight inclination inwards*, to avoid the epigastric artery. Before this step is accomplished, the operator should examine for the course of the cord, and take measures accordingly, so as not to injure it, see page 458, for the irregularity sometimes observed in the relations of the cord to the neck of the sac of this kind of hernia. When about to return the viscera, the direction in which the attempt is to be made to accomplish this object, is contrary to what is adopted for oblique or external hernia; in the latter, the surgeon passes the protruded parts obliquely upwards and outwards, then inwards; while in the former, he returns them directly inwards into the abdomen.

Scrotal Hernia of long standing and very voluminous. The operation in this variety is recommended* to be conducted in a different manner from the preceding methods, as the contents are so considerable, and often so altered from their healthy structure, that if they are attempted to be returned into the abdomen, either inflam-

* Cooper, Lawrence.

mation will ensue, or the visceral cavity may have become so diminished that it cannot accommodate itself to their presence, when great distress will be produced if they are forced into it; or the contents may be so adherent to the sac that it is impossible to liberate them from each other, without a tedious dissection, which may also give rise to extensive inflammation, that might extend into the abdomen, and destroy the patient. It is also conceived by those authorities, that the free exposure of so large a cavity as the hernia forms in this instance, would be alone sufficient, to excite considerable risk.

To guard against such dangers the operation is performed as follows: *1st*, the common integuments being divided for two inches over the abdominal ring: *2nd*, the fascia that covers the sac is next exposed, and cut through for the same length as the skin: *3rd*, the operator now either passes a director underneath it, or, if possible, his finger, and propels it upwards and outwards, to the situation of the parts that constitute the stricture, and divides them. If much difficulty attends this part of the operation, a small opening may be made in the sac, close to the abdominal ring, when both the neck of the sac and the other parts that form the stricture, can be divided with ease: *4th*, no attempt is to be made to return the parts so liberated, for the reasons already mentioned; but if well-directed pressure be applied, and continued for some time, a por-

tion of the protruded parts may be ultimately drawn into the abdomen, by a species of slow traction exerted upon them, by the cellular tissue.

Crural or femoral Hernia. The descent of the abdominal contents to constitute this species of hernia, takes place through the crural ring into the crural canal, and partly emerges from it to form a tumour at the superior and internal surface of the thigh near to the pubes.

Femoral hernia may be considered peculiar to the female, as inguinal is to the male ; in five hundred and ninety-three cases, five hundred and ten were met with in the former, and the remainder in the latter. Owing to the narrowness of the space through which it has to pass, and the resistance offered by it, crural hernia increases slowly, and scarcely ever attains a considerable size ; *form*, in the incipient stage it is elongated or oblong, presenting the appearance of an enlarged inguinal gland ; however, according as it augments, it assumes somewhat of a globular shape ; and when it escapes from the crural canal and is compelled to turn over Poupart's ligament, it has not inaptly been compared by Sir A. Cooper to the form of a Dutch bottle. 

In some cases mentioned by Munro and Hesselbach, the herniary tumour presented a lobulated form, caused either by the unequal thickness of the sac, or by unequal pressure of the superincumbent parts.

The contents of this hernia are generally a

portion of the omentum and knuckle of the small intestine, sometimes the cæcum or colon. *Sac;* the hernial sac is generally thin, and seldom contains any serosity; yet the opposite is occasionally observed. The neck is always powerfully contracted, being confined anteriorly by Poupart's ligament, posteriorly by the pubes, internally by the concave, unyielding, and sharp edge of Gimbernaut's ligament, while the crural vein, the only yielding part of the circumference of this opening, defines it externally.

An acquaintance with the relations of the blood vessels in the vicinity of the neck of the sac is of the greatest importance to the surgeon for the safe performance of the operation, and are as follows in the female:—the commencement of the crural vein is immediately external to it, the epigastric artery, which arises from the termination of the external iliac, generally by a separate trunk, courses upwards, and inclines inwards to its destination, and should be considered as circumscribing a portion of the neck of the sac, on its external and superior side, while the round ligament of the uterus, with its small vessels, run anterior to it; when the obturator artery arises irregularly, *i. e.* from the termination of the external iliac, from the epigastric, or from the crural, it may pass either posterior to the neck of the sac, or anterior to it, and then descend on its internal side into the pelvis. When all these vascular relations are taken into account, we find

this portion of the sac, 1st, in the usual arrangement of the parts connected externally and superiorly with vessels: 2nd, externally, superiorly, and inferiorly: or, 3rd, externally, superiorly, and internally.

In the male subject, the neck of the sac is related on its anterior aspect to the spermatic cord and its vessels, leaving but a minute portion of it free for the division of the stricture, without danger of wounding any part of importance.

Sometimes double femoral hernia exist in the same subject, (*Scarpa, Sandifort,*) but never at the same side.

Coverings of femoral Hernia. If the sac has been forced out of the crural canal, the superincumbent parts are few in number, and very thin, unless the patient is very fat, and are as follows: 1st, the common integuments, underneath which there may be adipose substance in considerable or in small quantity: 2nd, the superficial fascia: 3rd, the fascia propria, which is always very thin and delicate: 4th, the sac:—when the hernia has not started from the crural canal, but is lodged *within it*, in addition to the coverings just mentioned, it is also defended by a process of the fascia lata, named the cribriform (*Colles*). Occasionally some of the crural lymphatic glands are situated over the sac.

Operation. The patient being placed upon a table with the legs hanging over the edge, and

the hair removed from the groin and pubes.

First period. A choice of three incisions is submitted to the operator, the crucial, the \perp shaped, and the linear; the two first afford flaps, which are to be dissected cautiously from the subjacent parts; to make the last effectually available, it should be of some length; and pass over the tumour from above obliquely downwards and outwards.

Second period. The superficial fascia is next to be divided in the same direction as the skin, and the adipose membrane cleared away; *when this fascia (superficial) is divided, the tumour is so far exposed, that the circumscribed form of the hernia may be distinctly seen, and a person not well acquainted with the anatomy of the parts, would readily suppose that the sac itself was laid bare.* This is not the case, for it is still enveloped by a membrane, which is the fascia, that the hernial sac forces before it, as it passes through the inner side of the crural sheath.—*Cooper, Crural Hernia, p. 16.*

Third period. This membrane is then to be opened longitudinally for the whole extent of the sac, and with every possible care to the subjacent peritoneal sac.

This is the most difficult part of the operation, for the fascia is very liable to be mistaken for the sac itself, so that when it is divided, it is supposed that the sac is exposed and the intestine laid bare; following up this idea, the stricture is divided in the outer part of the sac, and the intestine, still strangulated, is pushed with

the unopened sac into the cavity of the abdomen.—*Cooper*, p. 16. *Fourth period.* The operator next opens the sac with the necessary precautions to protect the contained parts, which is more imperative in crural hernia than in inguinal, since it seldom holds any fluid, and introduces his finger along the internal side of it upwards in quest of the stricture, which in this variety of hernia is almost always deeply seated, and presents a most defined and sharp edge, so much so, that the hernia requires to be handled with the greatest delicacy, otherwise the part of the intestine corresponding to the neck of the sac, will incur imminent danger of being ruptured.

Division of the stricture.—Few subjects have occupied the attention of anatomists and surgeons more in operative surgery, than the division of the stricture in femoral hernia; Sir A. Cooper refers the situation to no less than three places; for the first, he says, “the finger is to be pushed into the anterior part of the sac, and the sheath is to be cut as far as the anterior edge of the crural arch, for the second,” “if the intestine when slightly compressed cannot be readily emptied, then the finger must be passed at least half an inch higher, and then the posterior edge of the crural arch and the fascia that covers it, will be felt forming a sharp edge, strongly compressing the mouth of the sac. To divide this edge the knife must be carried within the stric-

ture, and being inclined obliquely inwards and upwards at right angles with the crural arch, a cut may be very safely made in that direction, sufficiently for the purpose of liberating the intestine from pressure. These two incisions being made from the interior of the sac, any stricture that may arise from the contraction of the sac, will be at the same time removed, and the protruded parts be thus completely liberated.*

Mr. Lawrence† advises the thin posterior border of the crural arch to be divided, that is, as nearly as we can to its insertion into the pubes.

M. Dupuytren acts in a different manner from the preceding surgeons, and divides the stricture from *within without*, from *below upwards*, and *parallel to the spermatic vessels*,‡ for which purpose he makes use of the convex edge hernial knife, recommended at page 461.

The editors of the French work referred to at the foot of the page, state, that they have never witnessed haemorrhage to supervene after dividing the stricture in this direction.

If the student will consult the anatomy of the parts engaged in femoral hernia, he will see that by this proceeding, that the lunated edge of the fascia lata, named Hey's falciform ligament, is what is principally divided, and which will cer-

* Cooper, crural hernia, p. 16, 17.

† Lawrence on Ruptures, p. 409.

‡ Med. Oper. par Sabatier, tom. iii. p. 529.

tainly have the effect of relaxing to some extent the crural ring.

With the same intention, it is recommended to cut the pubic portion of the fascia lata near to the pubes.*

As far as the author's opportunities have permitted him to judge from a few dissections of femoral hernia, and from examining the seat of stricture in the living, the neck of the sac was always constricted by what is termed Gimbernat's ligament, or the third insertion of Poupart's ligament.

By selecting this part of the circumference of the crural ring to divide, the operator is protected as far as human ingenuity can effect it for him, from committing any injury upon blood vessels; by freeing the stricture in this direction; the only vessel that can incur a risk, is the obturator artery, when it arises either from the epigastric, the termination of the external iliac, or the commencement of the femoral; see page 471, for the manner in which the neck of the sac may be surrounded by blood vessels.

Return of the protruded parts. If the hernia contains both omentum and intestine, the latter must be drawn down in a very gentle manner to examine in what state the constricted part of the intestine is in, and if it is fit to be returned. The omentum, if healthy, is next to be passed

* Colles's Surg. Anat. p. 91.

into the abdominal cavity: if not, it is to be treated in the same way as in inguinal hernia.*

For the remaining varieties of hernia, the reader is referred to the works of Cooper, Scarpa, Lawrence, and Hesselbach, which treat, *ex professo*, of this affection.

Anatomy of inguinal and femoral Hernia. To comprehend, in a clear manner, the anatomy of the tissues engaged in inguinal and in femoral hernia, it is necessary to pass in review a part of the osseous structure of the pelvis, viz., that portion comprised between the anterior superior iliac spine, and the symphysis pubis.

It presents an irregularly indented edge, and is defined externally by the anterior superior spinous process of the ilium, to which is attached the external end of Poupart's ligament, or the tendon of the great oblique muscle, and other soft parts; a little below, and anterior to this process, is the anterior and inferior spinous process of the ilium; to it is inserted the tendon of the rectus femoris: these two osseous prominences are separated from each other by a slight hollow, from which arises the sartorius muscle.

About one inch internal to the inferior iliac process, a long elevation is observed, which indicates the point of

* *Vide* Cooper, plate iv. fig. 1. for a perfect delineation of the dissection of the various coverings of femoral hernia, this figure represents both omentum and intestine in the sac; also it explains the manner in which the saphena vein is protected from the knife by the herniary tumour: fig. 5 of the same plate exhibits the dissection of a small femoral hernia. In plate v. fig. 2, of the same work, the reader will see a most perfect and beautiful representation of the different coverings of this species of hernia.

union between the ilium and pubes ; this is termed by Cloquet the ileo-pectineal eminence, and into it the tendon of the psoas parvus muscle is attached, to the external side of this eminence, is a deep groove, which leads to the iliac fossa, and through it a great portion of the conjoined tendons of the psoas magnus and iliacus internus muscles descend to their insertion ; while to the internal side of this osseous elevation, a smooth surface, nearly horizontal, slightly concave, and of a triangular form, is observed to extend inwards ; the apex of which is situated at the tuberosity of the pubes, and the base at the junction of the pubes to the ilium, (the ileo-pectineal eminence). It is defined anteriorly and inferiorly by an obtuse edge that passes from the pubic tuberosity downwards and outwards, towards the cotyloid cavity, while it is circumscribed, superiorly and posteriorly, by a well marked ridge of bone, that runs from the tuberosity of the pubes, backwards and inwards along the superior strait of the pelvis, and is named the ileo-pectineal line (by Cloquet, the pubic crest) ; to it is attached the tendinous expansion of the crural arch, or the third insertion of the great oblique tendon, better known in femoral hernia, by the name of Gimbernat's ligament ; also a portion of the pectineus muscle. This triangular surface is of great importance in femoral hernia ; it is covered in the recent state by the pectineus muscle, also by a very strong fascia which constitutes the internal or pubic origin of fascia lata of the thigh.

The tuberosity of the pubes is always a well developed process, and has inserted into it a portion of the tendon of the great oblique, or the external, inferior, or posterior pillar of the abdominal ring ; this portion of

bone is nearly one and a quarter inch distant from the symphysis pubis, where the angle of the pubes is situated ; into which, and the symphysis, the internal, superior, or anterior pillar of the abdominal ring is attached, a part of the tendon of the great oblique muscle of the abdomen.

The portion of the pubes comprised between the tuberosity (spine) and the angle, is of particular interest in inguinal hernia, and corresponds to the base of the triangle, which the external inguinal foramen most commonly represents ; upon it, the spermatic cord in the male, and the round ligament of the uterus, rest in their course through this opening.

When the crural arch is stretched across from the anterior spinous process of the ilium to the symphysis pubes, it, in conjunction with the bones, forms a triangle which is filled by the iliacus internus and psoas magnus muscles, by the anterior crural nerve, the femoral artery and vein, also by the third insertion of the crural arch or Gimbernat's ligament ; and it is further secured by numerous fascia, which will be more particularly explained when treating of femoral hernia.

Anatomy of inguinal hernia. A thin male subject, is the most desirable one to obtain a correct knowledge of the anatomy of the parts concerned in inguinal hernia ; the abdominal parieties being rendered tense, by placing a large block under the loins ; an incision is to extend from the anterior sup. spin. process of the ilium directly to the linea alba, and from it down to the symphysis pubis : the skin being dissected from the subjacent parts, and below Poupart's ligament, so as to gain a complete view of the groin, is then to be reflected on the top of the thigh.

The superficial fascia. This membrane now appears, which is observed to increase in thickness and strength as it approaches the pubes and groin; from the former it passes down into the scrotum, from the latter along the fascia lata of the thigh. When situated in the groin, it forms capsules for the glands of this region. This fascia is not always formed of but one layer, but sometimes consists of two or more; when the student removes it from the subjacent muscles, he finds that it is more adherent in some places than in others, *e. g.* in the vicinity of those lines, named lineæ transversales, semilunares and alba, also around the edges of the abdominal or the external ring, and contains in it a small artery and vein, named the external or lesser epigastric vessels.

In a physiological point of view, the fascia superficialis connects the integuments to the subjacent muscles, and allows the smaller vessels to penetrate through it before they are distributed to the skin; it also admits of considerable gliding motion of the tegumentary membrane over the deeper seated parts. By the process sent from it into the scrotum, it constitutes one of the envelopes of the testicle; and according to the opinion of a celebrated French anatomist, Cloquet, it is the superficial fascia from which the gubernaculum testis of the Hunters is derived in the foetal period of existence.

In addition to these offices which it naturally serves in the system, it is considered by all writers upon the disease under consideration, as strengthening the different foramina through which hernia protrude, consequently offering a barrier to their formation.

But it is, in its pathological conditions, that the su-

perficial fascia is so interesting to the surgeon, who should be well informed of the different alterations in structure it is subject to when under disease, being sometimes rendered dense and firm by it; at others completely attenuated to a mere cellular web; in the latter instance offering no resistance to the knife, while in the former it cannot be penetrated but by two or more divisions.

This difference in thickness, also induces the surgeon when operating for hernia, to penetrate through (the different lamina of) it with caution, that he may expose the parts beneath it without inflicting any unnecessary injury upon them.

Abdominal or external ring. When the superficial fascia is removed, the broad tendinous expansion of the external oblique, m. is brought into view, the fibres of which descend toward the pubes in a gently curved direction; they arise from the muscular structure in a concavc line which looks upwards and outwards; if the tendinous expansion of both muscles be fully exposed, they are seen to cover the whole of the anterior and inferior part of the abdomen, between the anterior superior iliac processes and the pubes. As the aponeurosis of the great oblique m. advances towards the pubes, when within an inch and a half, seldom I believe so far as two inches from it, some of the fibres separate, to admit the passage of the cremaster muscle and spermatic cord in the male, and the round ligament of the uterus in the female, the first to pass to the testicle, the second to the external or great labia pudendi; and in this manner the abdominal ring may be considered as formed.

The tendinous expansion of the external oblique is strengthened by a number of fibrous bands, which are interwoven with it, and extend from the femoral arch in a serpentine manner, over the top of the abdominal ring, and are lost on the internal side of it: they fix the limits of the inguinal ring, and seem intended to oppose the further divergence of the tendinous pillars towards the side.

After the superficial fascia has been removed and in a well marked subject, by a careful dissection, a fine but firm tendinous membrane can be detached from the lower part of the tendon of the external oblique muscle, as far as the crural arch with which it seems to be incorporated. This membrane is described by Scarpa as the aponeurosis of the *fascia lata*.

It can be separated from the aponeurosis of the external oblique muscle, every where except in two distinct places: viz. along the arch (as already mentioned) and close to the pillar of the inguinal ring, to which points it is found to adhere very closely. This aponeurosis is conceived by Scarpa, to add strength and elasticity to the femoral arch and inguinal ring. As by cutting it in the vicinity of these respective places, both the femoral arch and inguinal ring are relaxed.

When the cord is drawn down towards the scrotum, the outline of the abdominal ring is visible; and is clearly indicated, by incising through a thin fascia that is sent from its circumference to be gradually lost upon the spermatic cord, which is named the intercolumnar or spermatic fascia. When this opening is now examined, it seldom or ever presents a true annular form, as is to be expected from the nomenclature used by anatomists,

who employ the following terms to describe its boundaries : an internal, anterior, or superior pillar ; an external, inferior, or posterior pillar ; where these unite externally is situated what is termed the *external angle of the ring*, while the *internal angle* is placed in the opposite direction.

These terms, when applied to such a figure as a ring, are very unintelligible, consequently productive of much confusion ; if the student will divest himself of the idea of the annular form of this foramen, and will regard it as a triangle, (in almost every subject it presents that shape) he will better perceive the propriety of the nomenclature which is employed : as the internal and external pillars will represent the sides of the triangle, the apex of it will correspond to the external one of the ring, while what is termed the internal angle, with more propriety, should be considered as the base, having for its extent the distance between the insertion of the internal and external pillars to the pubes, or the space between the tuberosity and symphysis of that bone.

The abdominal ring is now seen to extend obliquely upwards and outwards, towards the superior, anterior, iliac spine, and is nearly parallel to Poupart's ligament, but the superior angle diverges a little from it.

The internal pillar is thin and flat, and is attached to the symphysis and to the opposite pubes, decussating with the analogous pillar from the opposite side : while the external pillar is of a different appearance, being thick and cord like, and is united to the tuberosity of the pubes, in part tucking in under Poupart's ligament ; it is always stronger than the other ; the abdominal ring is partly strengthened by the attachment of the fascia

superficialis, also by a thin membranous production, furnished on each side from its circumference, and which is lost upon the parts that traverse it, named by some the intercolumnar fascia, or the fascia spermatica.

The spermatic cord and round ligament do not pass through the axis of the opening, but invariably are nearer to the external than the internal boundary, so that in the male, the spermatic cord runs over the insertion of the external pillar, and conceals it from view; the round ligament more approaches the axis of the opening in its passage through it, than the cord.

It is almost needless to mention, that the abdominal ring is larger in the male than in the female, occasionally exceptions are observed to this formation.

In a pathological consideration, the abdominal ring affords but a weak obstacle to the formation of hernia, and were it not that this foramen was protected by other parts, it would be a very frequent affection.

Internal oblique muscle. To expose the deeper seated parts, it will now be necessary to make an incision from the anterior sup. spin. process of the ilium, directly across the tendon of the external oblique muscle to the linea alba, and another at right angles to it, to the symphysis pubis; this angular flap of the aponeurosis is then to be reflected downwards upon the top of the thigh; being attentive to preserve the *integrity of the external ring*, the inferior portion of the internal oblique muscle is thus exposed, and a more intelligible view of the course of the spermatic cord is obtained by drawing it gently downwards, when the outline will be distinctly seen stretching upwards and outwards towards

the anterior sup. spinous process of the ilium, and diverging a little externally from the crural arch.

The inferior portion of the internal oblique muscle with which we are alone concerned, arises from the anterior superior spinous process of the ilium, also from about the two external thirds of the fossa formed by Poupart's ligament; the fibres derived from these origins are very thin, and pass inwards nearly in a transverse course to be inserted into the linea alba in common with the transversalis abdominis, constituting the conjoined tendons of these two muscles; also into that part of the pubes, between the tuberosity and angle, and posterior to the internal pillar of the abdominal ring. From the manner that this muscle is disposed of, it strengthens both the openings of the inguinal canal; the superior one, by covering it as it passes from its origin to its insertion; and the inferior one by its tendon, which lies posterior and within the area of the opening in this manner, opposing a barrier to the production of hernia of the direct descent. This arrangement is more intelligible in the female than in the male subject.

Cremaster muscle. The spermatic cord is concealed in the present stage of the dissection by the cremaster muscle, which is generally a weak fasciculus of fibres, described by Scarpa to arise from Poupart's ligament about eight lines distant from the apex of the abdominal ring, and to pass downwards along the cord through the ring, to be ultimately expended upon the subcutaneous coverings of the scrotum; he further describes, a second and weaker origin to the muscle, by means of a tendinous origin from the tuberosity of the pubes, posterior to the internal pillar of the ring, which also penetrates through this foramen, and is insensibly distributed upon

the cord. A more interesting manner of considering the formation of this muscle, is to take the same view of it with Cloquet, who conceives it to be derived from the internal oblique muscle in the following manner; prior to the descent of the testicle, the internal oblique muscle closes up the area of the abdominal ring posteriorly, allowing but the gubernaculum testis to pass through it; however, according as the testicle advances from the abdomen into the scrotum, it meets with the fibres of the obliquus internus that close up the area of the abdominal ring, and protrudes them before it, when they assume two different arrangements: 1st, and the most usual, the muscular fibres are placed anterior to the spermatic cord and tunica vaginalis: 2nd, the muscle may be equally distributed to the anterior and posterior part of the same structures, and thus supports them in a sling. According as the muscular fibres of the internal oblique are continued far across the abdominal ring, so is the internal origin of the cremaster muscle well defined or otherwise.

It is very rare if any part of the cremaster arises from the transversalis abdominis muscle; both Scarpa and Cloquet think that it never has any origin from it. Though doubted by such good authorities, I am pretty confident that I have sometimes witnessed an origin from that muscle.

In the female, the inferior fibres of the internal oblique are much thinner than in the male, and pass over the round ligament, without entering into the abdominal ring, so that in the normal state, there is not a vestige of this muscle. But whenever external or oblique inguinal hernia occurs in the sex, it often pushes before it, in its

descent a few of the fibres of the internal oblique muscle, thus forming an accidental cremaster muscle.*

The cremaster muscle at its exit from the ring, is enveloped by the prolongation sent from the superficial fascia to the cord, and more immediately by a more delicate process, derived from the intercolumnar fascia.

Uses of the Cremaster. It forms a species of muscular sling for the support of the testicle, and can draw it up to the ring ; it may be also of some service in compressing the cord, and assist the flow of the seminal fluid along its duct to the urethra.

Pathology of this muscle. It always constitutes one of the coverings of oblique inguinal hernia, when it may present a well defined muscular appearance, or be much attenuated; or lastly, it may be unusually rigid and hard, presenting a yellow colour in very old hernia ; not unfrequently in old scrotal hernia, the fibres adhere very intimately to the edges of the inguinal ring (*Scarpa*).

I have often seen the muscle to offer the two first appearances, but have had no opportunity of witnessing the change in colour.

The spontaneous reduction of hernia is sometimes effected by the cremaster, which supports the parts protruded as in a muscular sling, and by its contraction will cause them to return into the abdominal cavity. I conceive it is more correct to attribute this phenomenon to the muscle in question than solely to any corrugation of the dartos and integuments : still, I do not deny but that the latter may be of some use. The reader is referred

* Cloquet, Recherch. Anat. sur les Hernies de l'Abdomen, p. 21.

to Copeland Hutchinson's writings for some curious examples of the voluntary action of this muscle by malingering seamen. Quere, will not this fact go far to establish the truth of M. Cloquet's description of the muscle, who considers it as derived from the internal oblique, as already stated ?

Transversalis abdominis muscle. By making an incision through the internal oblique, similar to the one that has been made in the tendon of the great oblique, and throwing it down on the thigh, the inferior edge of the transversalis abdominis muscle and the inguinal canal are brought into view ; by dragging the cord downwards, the place at which it penetrates beneath the inferior edge of the transverse muscle to pass apparently into the abdomen, is indicated.

The inferior fibres of this muscle, and which arise from the external third of Poupart's ligament, are very thin, and pass inwards ; they soon give rise to a delicate fascia, which unites with that of the lesser oblique, and is inserted into the linea alba and horizontal portion of the pubes, before the tendon of the rectus abdom., but posterior to the pyramidalis and internal pillar of the abdomen.

The lower edge of this muscle curves over the superior opening of the inguinal canal ; in some few instances the transversalis muscle has no relation to the superior inguinal opening, as it is neither attached to the crural arch or to the pubes, not extending beyond the anterior superior spinous process ; the inferior edge in this case being distant from the inguinal canal two inches.

The spermatic cord is occasionally seen to enter the

inguinal canal by passing between some of the fibres of the transversalis muscle (*Cloquet*).

The transversalis abdominis muscle is covered by the lesser oblique, while it rests upon the transversalis fascia, and is generally intimately connected to it by a close and dense cellular membrane.

It does not form so much opposition to the formation of oblique hernia as the lesser oblique, but contributes in an equal degree with it to prevent the occurrence of the direct species ; in hernia of the oblique descent, it not unfrequently, by its lower edge, constitutes stricture in conjunction with the internal ring.

Rectus abdominis Muscle. Is inserted by a tendon into the horizontal part of the pubes, behind the pyramidalis muscle and the internal pillar of the ring. The external edge of the tendon of this muscle is very thin, and in many individuals gives attachment to a portion of the transversalis fascia.

Fascia transversalis. This fascia lines the transversus abdominis muscle, and covers the peritoneum, it was first described by Sir A. Cooper ; who divides it into two portions, an external and an internal part ; the first is given off by the crural arch from the ilium to the place at which the femoral vessels pass out from the abdomen, and adheres to the iliacus internus muscle and crest of the ilium. This portion is united to the crural arch by a white line, which points out the course of the circumflex illi artery, which is readily seen when the peritoneum is stripped from the inner part of the abdominal muscles, and iliac fossa ; the second or internal portion, he describes as a thinner fascia sent upwards from the crural arch, behind the abdominal muscles, to which it gives a

lining similar to the tendinous expansion which covers them on the forepart.

It is this fascia that leaves an opening from the abdomen for the spermatic cord in the male, and round ligament of the uterus in the female.

Besides these origins, the fascia transversalis often is attached or arises from the external edge of the rectus abdominis m., which is gradually thinned for this purpose; in this situation the fascia is generally strongest, and is continuous with the third insertion of Poupart's (*Gimbernaut's*) ligament.

From these origins the fascia ascends covering the peritoneum, and is generally lost in cellular membrane on a line with the umbilicus. In one instance I have met with this fascia almost as strong as the fascia iliaca.

The fascia transversalis prevents the frequent occurrence of hernia, for if deficient, we would have this affection of very frequent formation.

Internal ring of the inguinal canal, between the ant. sup. spin. process of the ilium and the *symphysis pubis*, and about half an inch above Poupart's ligament, the transversalis fascia is pierced by an elongated foramen, the long diameter of which is *vertical*,* the internal edge of it is both thicker and better defined than the external, and is supported by a falciform process de-

* To find the internal ring with facility, or more properly speaking, to form it:—about an inch below its presumed situation, let the student raise the cellular membrane from the cord with a forceps, and pierce it with the blade of a scissors, then by cutting upwards towards the opening, and dividing the cellular tissue with short clips of the scissors, he will be guided to the ring, which will gape, and present the appearance now described.

rived from the crural arch. This orifice ought not be considered as a simple foramen, but rather as the enlarged entrance *entree évasé* of a funnel-shaped canal, (*Cloquet,*) which receives the spermatic vessels in the male, and forms their sheath, by sending a prolongation along it, which prevents the opening being seen:—in the female the round ligament of the uterus passes through it; the foramen is much smaller in that sex, and is also more difficult to be found than in the male.

The only part of consequence that passes between the fascia transversalis and peritoneum is the epigastric artery, which almost invariably runs close to the internal part of the internal ring.

The epigastric Artery. This vessel next claims attention from the student, who finds it to arise from the anterior and internal part of the termination of the external iliac artery, either upon a level with the crural arch, a little above or below it; after its origin, it comes forward to the anterior parietes of the abdomen, and ascends in an oblique line inwards from the ilium, to be distributed to the rectus abd. muscle, giving some minor branches to the spermatic cord, fat and cellular membrane. Immediately after the origin of the epigastric it usually applies itself close to the internal circumference of the internal ring, which it partly strengthens; it is crossed anteriorly by the cord, which is also more or less supported by the vessel. In this part of its course it is distant about one inch from the outer side of the abdominal ring, and is always accompanied by the epigastric veins, the principal branches of which keep constantly on the inner side of the artery. About two inches after its origin the epigastric artery perforates the trans-

versalis fascia, to supply the rectus abdominis muscle. By examining the relation of this vessel to the internal and external rings, it will be seen that hernia of the oblique descent passes first external, and then becomes anterior to it—whilst direct hernia, with but one solitary exception (see page 458) has the artery on its outer side: it will be also evident by this examination, that the proper direction for the knife to take when freeing the stricture in oblique inguinal hernia is *upwards and outwards*, and for the direct hernia it is *upwards and slightly inwards*.

Formation of the inguinal canal. The different layers of tissues that are situated between the tendon of the external oblique, and the transversalis fascia, having been dissected, the form and course of this canal, can be now better understood. For this purpose let the tendon of the great external oblique m., and the transversalis fascia, be drawn upwards, and at the same time separated from each other, a membranous channel will be found extending from the ant. sup. spin. process of the ilium, to the symphysis pubis, formed anteriorly by the oblique tendon which forms the abdominal ring, posteriorly by the transversalis fascia, which contains the internal ring, inferiorly by Poupart's ligament, which presents its convexity downwards and outwards. I wish the student to observe that this channel is open superiorly, which will explain a difficulty and deception that may occur in the reduction of oblique hernia, and, if not counteracted, will lead to most unfortunate results; it has been noticed at page 465.

The floor of this channel can be divided into three parts of unequal length; the external one extends from

the sup. spinous process of the ilium to the internal ring, and is occupied by the internal oblique and transversalis muscles; the middle, is comprised between the two rings, and contains, not alone portions of the muscles already mentioned, but also the spermatic cord and cremaster muscle in the male, and the uterine round ligament in the female; while the internal part of the channel is limited by the space between the abdominal ring and the symphysis pubis, and is filled by the conjoined tendons of the internal oblique, and transversalis abdominis muscles; also by a small process of fascia of a triangular form, the inferior edge being attached to Poupart's ligament, the internal one to the tendon of the rectus abd. muscle, whilst the external is free and concave, looking upwards and outwards. It may be useful to observe, that this fascia, when well developed, is a great protection to the internal part of the abdominal ring, and strengthens it against the protrusion of direct hernia.

The superior opening of the inguinal canal, is situated about midway between the ant. sup. spin. process of the ilium and the symphysis pubis, it is about half an inch distant from Poupart's ligament; from this ring the canal extends to the external or abdominal ring, which is internal, inferior, and a little anterior to the superior opening of the inguinal canal.

From the oblique course of the inguinal canal, it is apparent, that the best protection against hernial protrusion is due, principally to a kind of valvular formation, effected by the arrangement of the parts constituting it, and not by their strength; this mechanism is rendered still more perfect, by the constant pressure of the abdominal muscles anteriorly, and the viscera posteriorly, from which it results, that the sides of the canal are

always more or less approximated to each other, and additional security afforded to prevent the protrusion of the viscera. If the inguinal canal of the adult and the very young subject be compared, with each other as regards the obliquity of their course, it will be seen that, that of the latter runs a more direct course from behind forwards, the two rings being nearly anterior and posterior, affording at this period of life a great predisposing cause to hernia, and which would be of more frequent occurrence, if the same exciting causes existed as do at the more advanced periods; but the canal becomes oblique according as the pelvis is developed, by the expansion of the ossa ilia, which compels the internal ring to follow them, and thus is carried outwards, causing the canal to increase in length and obliquity. It is from this peculiar and natural tendency, which the inguinal canal has, as we advance in life, to become oblique; that congenital hernia if reduced, and maintained so, for a couple of years when the patient is young, a radical cure will be produced: for during this interval, the two rings are separated from each other, the canal becomes more oblique, a kind of constantly acting valve is the result, which prevents the re-formation of hernia, unless a powerful exciting cause is called into action.

The inguinal canal is always better developed in the male than in the female, its two rings are also more distinct and well marked.

The following measurements of the parts engaged in the anatomy of inguinal hernia, are taken from Sir A. Cooper's work on hernia:*

* Cooper, Crural and Umbilical Hernia, p. 4.
U U

	Male.	Female.	Inches.	Inches.
From the symphysis pubis to the ant. superior spin. processs of the ilium ..	5 $\frac{3}{4}$	6		
..... to the tuberosity of the pubes ..	1 $\frac{1}{8}$	1 $\frac{3}{8}$		
..... to the <i>inner margin</i> of the lower opening of the abdominal canal ..	0 $\frac{7}{8}$	1		
..... to the <i>inner edge</i> of the internal abdominal ring ..	3	3 $\frac{1}{4}$		
..... to the middle of the iliac artery, ..	3 $\frac{1}{8}$	3 $\frac{3}{8}$		
..... to the iliac vein ..	2 $\frac{5}{8}$	2 $\frac{3}{4}$		
..... to the origin of the epigastric artery ..	3	3 $\frac{1}{4}$		
..... to the course of the epigastric artery on the inner side of the internal abdominal ring ..	2 $\frac{3}{4}$	2 $\frac{7}{8}$		
..... to the middle of the lunated edge of the fascia lata ..	3 $\frac{3}{4}$	2 $\frac{3}{4}$		
From the anterior edge of the crural arch, to the saphena vein ..	1	1 $\frac{1}{4}$		
From the symphysis pubis, to the middle of the crural ring ..	2 $\frac{1}{4}$	2 $\frac{3}{8}$		

Spermatic cord. When the peritoneum is raised from the iliac fossa, the component parts of the spermatic cord are seen passing to the internal ring, the artery and vein descending from the lumbar region, and the vas deferens ascending from the pelvis to hook over the epigastric artery and enter the canal. The relative position of the vessels and duct in their descent from this point (the internal ring) to the testicle, is as follows: the former are situated at the anterior part of the cord, the latter at the posterior aspect being united to each other by very lax and easily distended cellular membrane, as is established by artificial inflation, or by that arising from diffused hydrocele of the cord; so weak an adhesion explains the facility with which the spermatic cord can be unravelled by old hernia, producing a change in the relative situation of the vessels, and the vas deferens. The course of the spermatic cord from the superior opening of the canal to the testicle is—*1st*, downwards and inwards, till it has escaped from the abdominal ring: *2nd*, it then passes directly downwards into the scrotum; where the alteration of the course takes place, a large obtuse angle is formed, the vertex of which looks to the symphysis pubes.

Such a consideration of the parts interested in the anatomy of inguinal hernia, will allow us to enumerate the coverings it receives according as it passes from the abdomen to the scrotum, and are thus described in accordance to the anatomist's conception of its formation:—for external or oblique hernia they are:—*1st*, the peritoneal sac: *2nd*, a quantity of cellular membrane loaded with or free from fat: *3rd*, the fascia derived from the internal ring: *4th*, cellular membrane and the cremaster muscle: *5th*, the intercolumnar or spermatic fascia:

6th, the superficial fascia of variable thickness and resistance : 7th, the skin :—the coverings of internal or the direct hernia, are, 1st, the peritoneal sac and cellular membrane : 2nd, the transversalis fascia : 3rd, the conjoined tendons of the transversalis and internal oblique muscles, generally the hernia forces its way through the two last membranes ; 4th, the spermatic fascia : 5th, the superficial fascia : 6th, the skin ; can it ever be covered by any part of the cremaster muscle ? See page 466 on this point.

It can be now more readily comprehended, the manœuvre, which the surgeon is compelled to resort to in the reduction of inguinal hernia, of the oblique and direct descent ; or in the application of the taxis, as it is termed : for the first, it is necessary after the protruded parts have been passed through the external ring, to direct them obliquely upwards and outwards to the internal ring, then directly inwards through it. Whilst in the last kind, the efforts at reduction must be made almost directly backwards.

The relative situation of the two rings will also point out the most satisfactory manner to apply the pad of the truss for the support of reducible hernia, e. g. in the oblique kind it should be placed on the abdominal parietes, about midway between the anterior superior iliac process and the pubes, immediately above Poupart's ligament ; and in direct inguinal hernia over the abdominal ring, at the same time that care is taken not to allow the spermatic cord to intervene between the pubes and the pad, which will be productive of so much pain, that the patient cannot endure it ; he consequently moves the pad, when the hernia will immediately protrude, and be in danger either of strangulation or inflammation.

Anatomy of femoral Hernia. The student is recommended to refer to page 476 for the description of the osseous part of the pelvis, that is interested in the anatomy of this variety of hernia, and to pay particular attention to the tuberosity of the pubes and to the ileo-pectineal line. *Gimbernat's ligament.* The subject upon which inguinal hernia has been dissected, can also be made subservient to the uses of the student for femoral hernia. The peritoneum being removed from the iliac fossa, and the cellular membrane cleared away with the handle of a scalpel from the whole of this region, by running the finger in the groove of the crural arch, from the anterior iliac spine to the tuberosity of the pubes, when within a short distance of that bone, it will sink into a cavity; the femoral ring, the internal side of which is bounded by Gimbernat's ligament. This ligament is of a triangular shape, presenting an anterior, a posterior, and an external edge, the first is seen to be attached to the crural arch, the second extends from the tuberosity of the pubes backwards, for half or three-quarters of an inch, and is united to the ileo-pectineal line, while the third edge or base may be considered for the present as free, and constitutes the inner boundary of the crural ring.

By this examination it is easily conceived, that Gimbernat's ligament is derived from the crural arch, by a kind of expansion to close up a part of this great triangular space. It is generally weaker and less well defined in the female than in the male, hence the femoral ring of the former is always larger than the latter, to this some exceptions occasionally are found. It is necessary for the student to examine the third insertion of the cru-

ral arch with all possible care, and to investigate, if by any means by the attachment of other fascia, it is increased in breadth so as to strengthen this part of the abdomen, and to obviate the occurrence of hernia; for this purpose let the crural arch be drawn upwards by dragging upon the transversalis fascia, when it will be evident, that Gimbernat's ligament is towards its base partially augmented in breadth, by the adhesion of the transversalis fascia to it; by extending and rotating the thigh outwards, it is apparent that the base of the same ligament is also rendered tense and widened, by a process of fascia that curves from below upwards, and passes inwards beneath the crural arch, the origin of which will be better understood in the subsequent stages of the dissection. If the finger is insinuated into the ring and these different trials repeated, it will be found that the circumference of the opening is enlarged and diminished, according as the thigh is rotated outwards and extended, or according as traction is exerted on the transversalis fascia.

Superior opening of the crural canal. From the anterior superior spine of the ilium to the exit of the femoral artery from the pelvis, Poupart's ligament is attached posteriorly to the iliac fascia, which extends upwards over the iliacus internus muscle, and anteriorly to the transversalis fascia, by which a perfect barrier is opposed to the descent of any portion of the abdominal contents in this situation. From the femoral artery to the external edge of Gimbernat's ligament, the superior opening of the *crural canal* is situated; no viscera can pass through the external part of this outlet, as it is filled up by the artery and vein, which is still better protected by membranous septa sent from before backwards, by the

transversalis to the iliac fascia ; the only aperture through which it can admit the viscera, is immediately internal to the vein, and is the *crural ring*.

The weakness of this part of the fossa is readily established by passing the finger along the groove formed conjointly by the iliac fascia, Poupart's ligament, and the transversalis fascia ; when it arrives at the internal side of the vein it will sink into the ring, and by some pressure can be made to descend underneath the ligament to the top of the thigh.

Crural Ring. This opening is bounded anteriorly by Poupart's ligament, posteriorly by the pubes, which is covered by the pubic origin of the fascia lata, and the pectinalis muscle ; externally by the femoral vein, and internally by Gimbernat's ligament : besides these relations,—in the male the spermatic cord runs on the anterior part of the ring, while in the female the round ligament of the uterus passes in the same direction. This opening leads into the crural canal, the formation of which will be described in a subsequent stage of the dissection ; the crural ring is always covered by a fine and delicate fascia, which is derived from the condensation of the cellular membrane that binds down the external iliac artery and vein, as it approaches the ring, it is reflected from behind forwards so as to cover the area of that aperture : this fascia has been named the fascia propria of femoral hernia : sometimes the crural ring is blocked up by a large lymphatic gland.

As the seat of stricture is the most frequently situated in this foramen, the relations that it has to parts of any value, should be now considered—it has, external to it the femoral vein—external and superior to the ring,

ascending obliquely to the rectus muscle is the epigastric artery—which it would appear should forbid any attempt to free the stricture in this direction, still M. Dupuytren cuts obliquely upwards and outwards: anterior to the ring is the round uterine ligament, a wound of which is not of much consequence, but in the male, the spermatic cord is found in a similar situation, which will interdict any attempt to cut in this direction to liberate the stricture. Posteriorly, the pubes defines the crural ring; consequently it is useless to attempt any liberation of a stricture by dividing the parts in that situation; while to the internal side is Gimbernat's ligament, which mainly assists in forming the stricture, and which can be divided without any risk of wounding blood-vessels, except in but one very rare instance, viz. when the obturator artery is irregular in its origin and course, and may either arise from the epigastric or the external iliac artery; under these circumstances the obturator may run along the anterior and internal side of the ring, or by its posterior edge so as to gain the pelvis.

Crural region. The integuments are next to be dissected from the inguinal and crural region, for at least five inches below Poupart's ligament, and reflected down upon the thigh; the superficial fascia is thus exposed, which is observed to contain in it two sets of lymphatic glands, one superior and most numerous, which lie parallel to the ligament, the other consisting but of few, and are situated in the hollow of the thigh, being nearly perpendicular to Poupart's ligament: the course of the saphena vein may be also seen ascending to communicate with the femoral. The superficial fascia is now to be raised from the subjacent parts by a careful dissection;

particularly in the vicinity of what is termed the hollow of the thigh, until the saphena vein is fully exposed, where it penetrates the fascia lata; the superficial fascia is intimately united to that fascia, and explains one phenomenon that is always attendant on femoral hernia of any size; namely, the prevention of the descent of that tumour along the thigh, in consequence of which it is compelled to ascend towards the abdomen, and to cross the crural arch.

The manner in which the superficial fascia forms the capsules for the inguinal glands is now quite apparent, it is sometimes loaded with a large quantity of adeps.

Inferior opening of the crural canal. The saphena vein is now clearly exposed, lying upon the fascia lata; by drawing it downwards, the foramen through which it passes to empty itself into the femoral vein, which lies beneath the fascia lata, is readily indicated: this foramen looks directly forwards, and is of an oval form, the long diameter being vertical, varying from six to ten lines; it is generally situated nearer to Poupart's ligament in the female than in the male; the superior edge of it may be within four inches of that ligament, or it may be distant from it twelve or eighteen lines; this edge is always very badly marked, whilst the inferior one is the contrary, presenting a well defined crescentic line, resting in the angle formed by the junction of the saphena and femoral veins.

Crural canal. The situation of the two openings that communicate with this membranous conduit being known, the superior one corresponding to the crural ring, and the inferior to the communication of the saphena with the femoral vein.

It now remains to consider the formation of this canal, which is due to the manner in which the two origins of the fascia lata are separated from each other in the vicinity of Poupart's ligament; these are the external, the iliac or posterior origin, and the internal, the pubic or anterior one; the iliac portion arises from Poupart's ligament, from that part of it comprised between the anterior superior spinous process and the point, opposite to which the saphena vein joins the femoral: corresponding to these two places, this portion of the fascia forms two lunated edges; the superior one, named by Hey the femoral ligament, ascends under Poupart's ligament, and can be easily followed upwards to be attached to Poupart's ligament, which it increases in breadth; the concavity of this edge looks downwards and inwards: where the saphena vein communicates with the femoral vein we observe another lunated edge, which looks upwards and inwards, and indicates the attachment of the iliac part of the fascia lata to the pubic portion; in the space intervening between these two lunated edges, or from the termination of the saphena vein to Poupart's ligament, the fascia lata loses its dense and firm structure, and presents but a very delicate, almost cellular appearance; this portion of the fascia lata has been termed cribiform, (*Colles,*) it fills up the space between these two places, and owes its peculiar structure to the numbers of lymphatic vessels which pass through it. After having passed anterior to the vessels the cribiform fascia is united to the pubic part of the fascia lata, and forms an angle with it. This fascia may therefore be considered as forming the *anterior parietes of the femoral canal.*

Posterior and internal wall. To expose this side of the femoral canal, it is necessary to detach the cribiform fascia from the pubic portion of the fascia lata, and reflect it outwards, a very careful dissection is necessary to effect this object, or the *anterior portion of the sheath of the femoral vessels* will be also removed. The pubic or internal origin of the fascia lata is now brought into view, and is seen to arise from the horizontal part of the pubes, also from the ileo-pectineal line, where it covers the pectineus muscle; from these origins the fascia passes downwards and outwards, beneath the femoral vessels; it is this part of it which constitutes the parietes of this side of the canal, and is in part covered by the femoral vein; it is also at some distance from the anterior wall.

Posterior and external wall, is the smallest and shortest of the three, and is derived from the iliac portion of the fascia lata; it is concealed by the femoral artery and vein.

Sheath. Within this canal the sheath containing the femoral vessels is placed, which is very expanded superiorly, close to Poupart's ligament, and gradually contracts as it passes downwards along them.

It is considered as being formed anteriorly by a process sent down from the fascia transversalis; posteriorly by one derived from the iliac fascia; the first is intimately united to the crural arch, the second to the brim of the pelvis. To see the anterior parietes of the femoral sheath in the clearest and most satisfactory manner, the crural arch is alone to be divided by delicate touches of the knife, anterior to the femoral vessels; then by stretching gently the transversalis fascia, the

prolongation afforded by it is seen to pass down upon the vessels, also the two processes or septa, that pass from before backwards and separate the vessels from each other. This examination will also afford a correct idea of the situation of the crural ring, and the manner in which its internal portion is circumscribed by this fascia; the posterior part of the crural sheath can only be seen by dissecting the femoral vessels from their position, and bringing them forwards; when the prolongation of the iliac fascia is apparent, it has no effect whatever upon the parts that constrict the neck of the sac.

By recapitulating the parts through which the protruded viscera may pass and their coverings, it will be seen that the number of these will depend upon the circumstance, whether they have been driven external to the crural canal or are retained within it: *e. g.* if the parts are situated within the canal, they are covered by, 1st, the peritoneal sac: 2nd, the fascia propria: 3rd, the sheath of the femoral vessels: 4th, the anterior parietes of the femoral canal: 5th, the superficial fascia: 6th, the integuments; in this case the hernia is always small, and appears as an enlarged lymphatic gland. If the viscera, on the contrary, are forced external to the femoral sheath and canal, which is most frequently the case, they are then covered, 1st, by the hernial sac: 2nd, the fascia propria: 3rd, the superficial fascia: 4th, the skin; when the tumour presents somewhat of a globular form, and turns up over the crural ring. In this variety, the termination of the saphena vein in the femoral, is always overlaid by the hernia, which protects it from the operator's knife; while in the first kind, the vessel is not so completely covered by it; and conse-

quently incurs proportionate risk of being wounded during the performance of the operation.

The distances from the symphysis pubis to the different parts engaged in crural hernia, are as follow:

MALE.

	Inches.
From the symphysis pubis to the centre of the orifice of the sac ..	2
From the centre of the orifice of the sac to the external iliac artery ..	1
..... to the centre of the iliac vein ..	$0\frac{1}{2}$
..... to the origin of the epigastric artery ..	$0\frac{3}{4}$
..... to the inner edge of the internal abdominal ring ..	1
From the tuberosity of the pubes to the centre of the crural hernia ..	1

FEMALE.

Each measure is from $\frac{1}{8}$ to $\frac{1}{4}$ more, when the pelvis is large and well formed.*

* Cooper on Crural and Umbilical Hernia, p. 7.

CHAPTER XIII.

TREPHINING.

THREE different indications induce surgeons to have recourse to the operation of trephining or trepanning: 1st, either as an immediate remedial measure for the relief of symptoms actually present; 2nd, as a preventative measure; 3rd, to give exit to matter.

Under the first head, this operation is demanded to relieve the effects of compression, whether arising from extravasation of blood, or from depressed portions of the cranium, both of which produce the same effects, as to the suspension of the energies of the brain, and which will ultimately lead to dissolution if not obviated; under the second head; this operation is often most valuable to prevent the occurrence of inflammation, for instance, in those kinds of fractures termed the "stellated and pointed," also in "the punctured," where a piece of bone is driven from the cranium into the brain, the spiculæ of it in these cases press upon the contents of the cranium, and if not removed in time, they

will to a certainty produce inflammation; the mischief is then done, and the application of the trephine is useless, as additional injury is super-added to the existing inflammation, and the chances of recovery rendered more desperate: while, on the contrary, if the spiculae of bone had been removed in the first instance, in all probability no inflammation would have been excited, or if it sets in so very early, as immediately after the injury has been received; since one of the principal exciting causes of the inflammation, will be counteracted by the operation; the antiphlogistic plan will be more available in the surgeon's hands.

Under the third head, trephining is employed to give exit to pus, and "in compound fracture with depression, unattended with symptoms of compression, it is best to trephine or to raise the bone by the elevator.*

In some unusual instances, epilepsy has been cured by the fortunate application of the trephine; in such cases, the disease has been found to depend upon some spiculae of bone, or a part of a pointed instrument which pressed upon the brain.

Are there any parts of the cranium upon which the crown of a trephine should not be applied?—We are told not to apply it upon the an-

* Cooper's Lectures, by Tyrrell, vol. i. p. 343.

terior inferior angle of the parietal bone, that the spinous artery of the dura mater should not be injured; nor upon the course of the longitudinal or lateral sinuses, for similar reasons; nor over the frontal sinus. Is such advice to be followed? If the same good will result by not endangering any of these parts, no rational surgeon would select them; but if a fractured cranium or depressed piece of it has laid open any of these vessels, and that it cannot be elevated or remedied without wounding them, the mischief has been already committed by the accident, and the operator must proceed to relieve the patient of the consequences of it, even by a chance of wounding these interdicted parts a second time; nor need he be under any unnecessary apprehension of an alarming and uncontrollable hæmorrhage ensuing to it, as the hæmorrhage can always be commanded, not alone from the middle artery of the dura mater, but even from the termination of the longitudinal sinus in the torquular herophili* by very moderate pressure.

Operation. The instruments for this operation are all to be found in the usual trephining cases. If a depressed piece of bone calls for the operation, it can be restored to its situation, 1st, by means of the elevator, 2nd, by means of Hey's saw and the elevator, 3rd, by the use of the trephine.

* Oral communication from Surgeon Read of Mercer's Hospital.

By the elevator. The patient is to be so situated as that his head will be securely and firmly fixed; if the scalp has been laid open by the accident, it will be merely necessary to extend the wound with a scalpel, and clean the bone a little on each side of it, in order to gain room; and if the case demanding it depends upon a depressed piece of bone, in all probability the surgeon will be able to raise it to a level with the surrounding parts by means of the elevator, which is to be used on the principle of a lever of the first order, the sound and undepressed portion of bone affording the fulcrum for it to rest upon, when, by a gentle trial the depressed bone can be elevated to its natural position.

Hey's saw and the elevator. When a fissure exists in the cranium, so that one portion of the bone is forced underneath the other, it can often be elevated by the use of Hey's saw, in the following manner: the wound being enlarged, the portion of the bone that rests upon the depressed one is to be cut away by means of this instrument, which can make either a straight or a semi-lunar section, by using the straight or the convex edge of it; the elevator being then introduced beneath the depressed piece will raise it to a level with the cranium.

By the trephine. This instrument is never employed unless that the depressed bone cannot be restored to its natural situation, or removed in

toto, by either of the preceding plans, when it will be imperative for the surgeon to avail himself of its use. If the perforation of the cranium is demanded in consequence of a purulent collection of extravasated blood, or for certain kinds of fractures, the trephine is also employed; as it is necessary, in these particular cases, to make a full-sized opening, to afford the greatest relief to the patient.

In order to use the trephine, it will be proper to make a more extensive wound into the integuments of the head, which can be done by enlarging the original wound; or if no wound exists, as occasionally occurs in extravasation or purulent collections, a stellated incision is to be made through the scalp and the flaps dissected from the subjacent parts and reflected.

The trephine is then to be prepared for its office, by protruding the centre pin, or point on which it works, a quarter of an inch beyond the saw of the instrument, and which is then to be applied as close to the edge of the fracture as the sound bone will admit with safety: by such attention, the portion of the uninjured bone that will be removed, will be little more than half of the size of the circle of the instrument. If the trephine is employed for the purpose of removing the spiculæ dependent upon a stellated or punctured fracture, the crown of the trepan can be so applied as to include this portion within the area

of the circle : the trephine being placed and secured upon the bone, it is to be worked in *quarter circles*, and pressed firmly upon it until a groove has been made in the bone of such a depth as that no danger will be incurred of its slipping ; the centre pin is then to be withdrawn and the operation persevered in, when the quarter circles may be extended to half ones : during the progress of the operation, the pressure communicated to the instrument should be equal, so that it will penetrate through the bone in a regular manner, and divide it evenly. To inform himself if this is the case, the surgeon must, from time to time, withdraw the trephine, and examine with a tooth-pick or probe the depth to which it has penetrated, according as the thickness of the bone is reduced, the pressure must be diminished, or danger will be incurred of forcing the piece which is sawing, and the trephine with it, into the brain.

It is almost needless to observe to the operator that the cranium differs in thickness in the different periods of life, being thinnest in the young subject and thickest in the old one ; however, in very advanced periods of life, the thickness of the cranial bones diminishes in a trifling degree.

When trephining, the most cautious proceeding which the operator can adopt is, after the bone is conceived to be nearly penetrated, to attempt to raise it with the elevator ; if this can-

not be effected, the trephine must be again applied for a short period, and the elevator again employed; by a few alternate trials of this kind, the surgeon will be always enabled to cut out the bone and bring it away without ever inflicting any injury upon the contents of the cranium.

APPENDIX.

AORTA, page 116.—Mr. James' operation for securing this vessel, was undertaken secondarily; as the femoral had been tied by him a few days previously at the distal side of the tumour. The case will be found in Med. Chirurg. Trans. vol. xvi. part i. p. 1.

The common iliac artery, page 105.—Mr. Crampston's operation upon this vessel, and observations, are now printed in the Med. Chirg. Trans. vol. xvi. part i. p. 159.

Amputation in the hip joint, page 245. A successful case of this operation by Dr. Mott upon Mr. Vetches' principle, will be read in the Edin. Med. Surg. Journal, vol. xxix. p. 223.

Amputation in the knee joint, page 217.—Mr. Velpeau has operated in two cases very successfully in this joint; in one it was performed for necrosis of the leg, in the other in consequence of suppuration and hectic ensuing to a compound fracture of the leg. He also mentions a third case, which came under his observation of this operation. These cases, with the one in the text, present four favourable results. Lancet, vol. i. 1830-31, p. 68.

Extirpation of the head of the femur, page 267.— This operation was executed a short time since by Mr. Hewson, who effected it by means of a lunate flap, made from the soft parts above the great trochanter; it was turned down upon the limb, and the soft parts inserted into the trochanteric fossa were then divided; the bone was next partially luxated, and sawn a little above the trochanter minor. The patient survived the operation three months, when he declined, owing to excessive and large purulent collections, which were found to extend into the pelvis, through an opening in the cotyloid cavity.

The pathological parts are in the Medical School in Park-street.

Extirpation of the radius and ulna at their carpal extremities. Mr. Roux has lately performed this operation, and with every chance of preserving for the patient a useful hand. Med. Gazette, Sept. 11, 1830.

Extirpation of the clavicle to within an inch of the acromion end. Dr. Mott has achieved this operation with success, in a case of very large osteo-sarcoma; forty vessels were secured. Med. Gazette, vol. iii. p. 405.

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